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Two Electrical Sections and R. E. S. M. A. Meet at Chicago

Electrical Section, Engineering Division

Discussion of seven reports and presentation of a paper on lighting applications compressed into one-day session

THE Annual meeting of the Electrical Section, Engineering Division, Association of American Railroads, was called to order at 9:30 a.m., Tuesday, October 22, 1946, by Chairman J. M. Trissal, superintendent communication and electrical engineer, Illinois Central. After announcing that this was the first regular meeting of the Section held since 1941, he called upon J. B. Akers (chairman, Engineering Division, A. A. R.), chief engineer, Southern, to address the meeting. He called attention to the value of adding discussion to the compilation of reports and to the number of developments brought out during the war.

Twenty-five years of normal development had been, in many cases, compressed into four,—much work now being required to assimilate and adapt these developments to the railroads. He spoke specifically of electrical devices which permit the doing of things that were impossible only a few years ago,—one of these being the measurement of stresses in rails and bridges. As an example of the importance of electrical work, he quoted a recently published statement to the effect that nearly everything on the railroads now has a wire on it. He concluded by saying that management makes policies, but that it remains with engineers to translate these policies into fact.

W. S. Lacher, Secretary of the Section, reported on the activities of the Section, calling special attention to the work done during the war under the chairmanship of D. B. Thompson, mechanical and electrical engineer, New York Central. This work, which received little or no publicity, accomplished much in the conservation of critical materials, developed the requirements of black-out lighting, produced emergency specifications for wire crossings, obtained radio channels for train communication, etc.

A suggestion was made that the Section should periodically send out news bulletins covering new developments of interest to the Section. It was decided not to do this because of the effective work being done by technical publications.

Following a brief discussion of the present status of State codes applying to wire crossings, the Section proceeded with the presentation and discussion of its technical reports.

Power Supply

Four assignments reported on by the committee included (1) determination of useful life remaining in used dry batteries for trainmen's hand lanterns, (2) power supply for communication equipment on cabooses and locomotives, (3) power for camp cars, and (4) economics of high voltage distribution within shop buildings.

Determination of Battery Life

The remaining life in a battery is determined by discharging it through a 16-ohm resistance for 1 minute. The panel for testing is shown in Fig. 1, and the circuit diagram in Fig. 2. The voltage under load is a direct indication of the remaining hours of life left in the battery, and the voltmeter is calibrated to show the hours of life remaining in the battery. Where the testers are used, they are applied to batteries turned in by trainmen, and if the test shows there are less than 8 hours remaining life in the battery, a new one is issued. Results obtained have been highly satisfactory. Out of 52 batteries turned in during the week, at one location, 31 were returned to service with the resulting total saving of 781 hours of life.

Power for Cabooses and Locomotives

A study of power for train communication needs was made and reported on by R. J. Needham, mechanical and electrical engineer, Canadian National Railways. His findings show that communication standby needs range from 100 to 300 watts, and operating needs from 200 to 600 watts. On steam locomotives this can usually be taken from the steam turbine-driven generator, when it has a total capacity of 1,000 to 2,000 watts. Where the capacity is insufficient, a 500 to 1,000-watt unit is usually installed.

It is possible to have a generator which will deliver the desired 117-volt, 60-cycle, single-phase power, and when the power is originated at 32 or 64 volts d.c., it may be converted by means of vibrator-inverters, rotary-inverters, dynamotors, or motor-generator sets. On Diesel-electric locomotives, the required power is usually obtained from the control battery and auxiliary generator.

On cabooses, power is generated variously by means of axle generators, and various types of internal combustion engine-driven generators. One road is experimenting with a variable frequency, axle-driven induction alternator, operated in conjunction with a rectifier and battery.

Wayside power is needed for charging batteries on cabooses where power is taken from the truck axle. In one case, an electric welding set is used for this purpose, with charging outlets placed at convenient locations. Several railways are using portable engine-driven charging sets, and an energized third rail for charging has been suggested, but the report questions the practicality of such an installation.

It is also suggested that where motor generators or rotary converters are used between the battery and the radio sets, they could be driven over-speed sufficiently to produce a voltage that would charge a battery. This could be done in the terminal by means

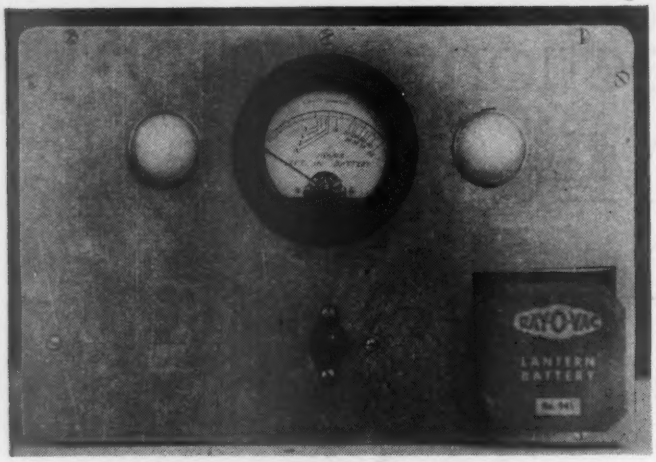


Fig. 1—View of the battery tester

of a separate motor or by driving the a. c. machine from standby power and raising the excitation on the d.c. machine sufficiently to charge the batteries. Mr. Needham sums up his investigation as follows:

Of the seven railways communicated with, four were employing axle-driven generating equipment for a power supply for cabooses, with a 32-volt battery for standby, although some of these were also trying out internal combustion engines, but there was no uniformity in the practice as yet.

It would appear desirable to have 117-volt a.c., 60-cycle wayside service near the caboose track in the yard so that when communication is required between the train crew and the yard office or dispatcher when cabooses are tied up, no power will have to be taken from the standby battery; also when internal combustion engine-driven generators are used they can be shut down while the cabooses are tied up in the yard.

No wayside power service is required for locomotives.

So many different arrangements for a power supply for the caboose radio equipment are now on trial, all of which have some merit and none of which might be considered as final, it would not be desirable at this time to make any definite recommendations as to a means of providing wayside power service for radio equipped cabooses. If internal combustion power equipment is found to prevail, no battery charging wayside service is required.

Power Supply for Camp Cars

The proper method of supplying power to camp cars from local circuits is reported upon by H. A. Hudson, signal and electrical superintendent, Southern Railway, as follows:

In recent years the use of electric power for lighting and the operation of tools in camp cars has greatly increased, with the

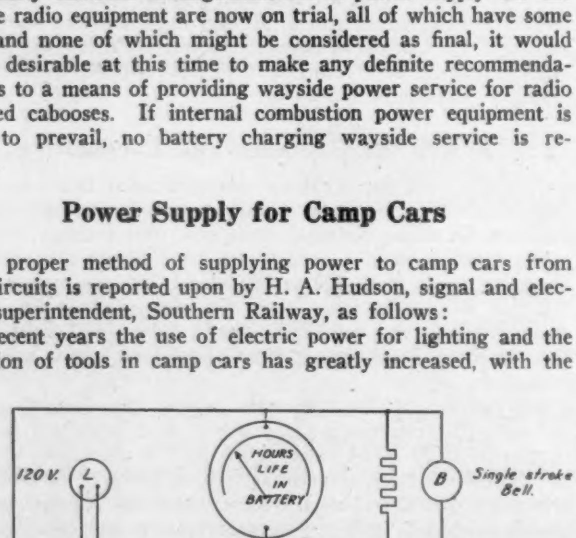


Fig. 2—Wiring diagram for the battery tester

result that the method of supplying power requires more attention to assure dependable service and to eliminate fire hazards.

Because camp cars are frequently moved to different points on the railroad, it is necessary that the power supply arrangement be of a portable nature. Therefore, each camp car outfit should be equipped with a rubber covered connecting cord of sufficient capacity and length. Also, a switch and overload protection should be provided at the camp cars at the point where the portable cord terminates.

There are locations on certain tracks on the divisions where camp cars are regularly placed. At such locations, a permanent load center should be established with proper switching and overload protective devices. One or more plug receptacles should be permanently attached to a pole or switch box in order that the portable cord which is connected to the camp cars can be plugged into the appropriate receptacle by a member of the camp car personnel.

At outlying points where camp cars are regularly placed near stations or other buildings, which are wired for electric power, one or more independent branch circuits of sufficient capacity and properly fused should be installed with a plug receptacle located at some convenient outside point. This will permit the portable cable which is used by the camp outfits to be connected to the power supply and insure safe and dependable service.

The following precautions must be observed in supplying electric power to camp cars:

1. Lighting and power circuits for camp cars must not be connected to a power supply except at locations approved by the proper authority.

2. Camp car wiring must be installed in accordance with the National Electrical Code and the work performed by qualified electricians. The cars must be equipped with a main switch and overload protective device of the proper capacity.

3. A Type S rubber-covered portable cord with proper plugs and receptacles and having sufficient capacity must be used for connecting the cars to the power service. Twisted pair or code wire should not be used for this purpose because of the possibility of grounds or failures. The plug receptacle at the car should be so arranged that in the event cars are moved while connection is made, the cord will automatically disconnect from the supply source without damage to the equipment and without exposing connections which would be hazardous.

4. Camp cars must not be connected to branch circuits at buildings when such circuits are in use for other service. Also, they must not be connected to open wire distribution lines unless the connection is made by a qualified electrician who is familiar with load conditions of the line. Such connections must be made in accordance with code regulations.

5. The power supply for camp cars must not be connected to automatic block or highway crossing signal control circuits.

High Voltage Shop Power Distribution

The economics of high voltage distribution within shop buildings was studied and reported upon by S. D. Kutner, assistant engineer, New York Central Railroad. The general advantages of such power distribution are listed by Mr. Kutner as follows:

The high voltage system of distribution can more easily be applied to new shop installations but it can also be applied to the modernization of existing shops. The most modern way of distributing electric power within a shop is by means of the load-center system which is built around factory-assembled unit substations for transforming power from distribution voltage to utilization voltage. Delivered ready to install near the center of electrical load areas, they cut weeks of time ordinarily required for installation.

However, even greater savings in time can be realized by using standard equipment in standard arrangements. Actual experience demonstrates that such a system can be designed, purchased and installed, and placed in operation in one to six months' less time than is ordinarily required.

In the load-center system, power is distributed at relatively high voltage (2.4 to 13.2 kv.) within the shop to load-center unit substations located, as already stated, near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the loads through draw-out air circuit breakers and short secondary feeders. By keeping the heavy secondary feeders to the minimum length, considerably less copper is required and the performance of motors, lamps,

etc., is materially improved by the resultant reduction in voltage drop.

Following this introduction, Mr. Kutner describes and illustrates several more advantageous arrangements of substations and circuits, and concludes by showing the considerable copper savings made possible by load center distribution.

The report is signed by C. P. Trueax, (*chairman*), assistant electrical engineer, Illinois Central; S. D. Kutner, (*vice-chairman*), assistant engineer, New York Central; R. Beeuwkes, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific; H. F. Brown, engineer electric traction, New York, New Haven & Hartford; H. A. Hudson, signal and electrical superintendent, Southern; R. J. Needham, mechanical and electrical engineer, Canadian National; J. A. Shaw, general electrical engineer, Canadian Pacific.

Discussion

Referring to that part of the report which outlines the means for testing trainmen's batteries, Chairman Trissal said the Illinois Central spends $53,000 a year for such batteries, and that between 25 and 40 per cent of this cost could be saved by the test methods shown in the report. Representatives of other roads reported on other types of testing which have been used, but it was the consensus of opinion that the method shown in the report was better than any other developed previously.

The question of power for camp cars produced the fact that the Baltimore and Ohio has recently placed in service two trains used by the Signal Department in which the primary source of power consists of gas-engine-driven generators. These trains are also equipped with necessary couplers and connectors and protective devices for obtaining power from wayside lines. In some cases such cars have been the cause of trouble because their power circuits have been connected to 440-volt signal power lines. A question was raised as to whether 480-volt lighting circuits should be used as a source of power, but it was agreed that the maximum should be 220 volts.

A paper on power requirements for Diesel-electric locomotive repair shops by H. F. Brown, engineer electric traction, New York, New Haven and Hartford, was presented as a supplement to the report. It was suggested that in such shops, the necessary d.c. power might be obtained by the use of ignitron rectifiers and that electric or oil-fired steam generators might supply the limited amount of steam necessary for cleaning filters and other requirements.

Electrolysis

For nearly four years, the Committee on Electrolysis has been conducting tests on the electrolytic corrosion of steel in concrete. Steel specimens encased in concrete cylinders of varying thickness, with varying diameters and coatings, were buried in the ground and subjected to a potential of 25 volts d. c. Reports on these tests were published in the December, 1944 and January, 1946 issues of *Railway Mechanical Engineer.*

These tests showed that asphalt waterproofing was very effective in preventing electrolytic corrosion; that the thickness of the concrete covering or use of admixtures was not particularly effective; and that the use of steel encasement resulted in deterioration of the concrete for the particular conditions of the test.

In addition to the electrolytic corrosion of the steel, it was found that the concrete surrounding the steel had deteriorated in the tests, and a study of the deteriorated concrete indicated that this was due to sulfate attack. Accordingly, plans were made to install a second series of tests during 1946 to determine the benefits from using sulfate-resisting cement, the effect of a completely enclosed steel encasement, the electrolyte corrosion of stainless steel, the effect of using emulsified asphalt in the concrete, and to develop practical means of pouring concrete in asphalt-lined forms.

It is expected that the installation of the second series of tests will be completed by October of 1946. A constant d.c. potential of 25 volts will then be maintained on the test specimens as was done previously, and current flow readings will be taken periodically. It is hoped that the results of this second series of tests will be available for the committee report next year.

The report is signed by A. E. Archambault, (*chairman*), assistant engineer, New York Central; H. P. Wright, (*vice-chairman*), assistant electrical engineer, Baltimore & Ohio; R. Beeuwkes, electrical engineer, Chicago, Milwaukee, St. Paul & Pacific; Paul Lebenbaum, electrical engineer, Southern Pacific; G. K. Shands, general foreman, Virginian; J. M. Trissal, superintendent communication and electrical engineer, Illinois Central; S. M. Viele, assistant engineer, office of electrical engineer, Pennsylvania.

Discussion

The question was raised as to whether piers under great depths of water (200 to 500 ft. being cited), which could not be reached after they were installed, might be subject to disintegration caused by electrolytic corrosion of the re-enforcing steel. It was explained that the type of corrosion being studied was present only in those places where there were stray d.c. currents and that this would be highly improbable in piers of this kind. Such corrosion can be caused in the vicinity of street car lines, and on the Illinois Central it has necessitated changing out all guy anchors.

Concerning the use of cathodic protection of buried metal structures, the question was raised as to whether or not consideration should be given to the allocation of power costs since power is required for such protection. This is a matter of principal concern to pipe line companies, and members of the Section suggested that the roads do not participate in the discussion of this matter, but that the Section be kept informed of work being done in this field.

In discussing anodic protection of water tanks, one member described a tank which had pitted badly. Each leak was repaired by drilling and tapping the hole and fitting the hole with a pipe plug. After approximately 1,000 plugs had been used for this purpose, anodic protection was applied and corrosion stopped.

The question of whether or not electric switch heaters should be connected by means of plugs and receptacles, or wired solidly to the supply circuit, brought out the fact that the plug-in type does not find favor among the members.

Illumination

Under the heading of illumination, the committee presented a reprint of an article on recent lighting installations in shops and offices on the Pennsylvania, which appeared in the July, 1946, issue of Railway Mechanical Engineer. This article, with a number of photographs, shows notable examples of good lighting for shops and offices. In several cases, illumination levels have been trebled without increasing power consumption, and in some instances unique advantage has been taken of the potentialities of high intensity mercury and fluorescent light sources.

Lighting of Engine Terminal Facilities

A description of new lighting in the West Burlington, Iowa, shops of the Chicago, Burlington & Quincy Railroad, is included in the report to cover the committee's assignment on the lighting of engine terminal facilities. This section of the report, which follows, was prepared by J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy.

This shop was built as a machine and erecting shop for steam locomotive repairs. The buildings, 310 ft. wide by 792 ft. long, is divided into four bays,—a light machine bay, 70 ft. wide; an erecting bay, 100 ft. wide, with three longitudinal pit tracks; a north heavy machine bay, 70 ft. wide; and a south heavy machine bay, 70 ft. wide.

As the railroad has many Diesel-electric locomotives in service, it was decided to remodel the south heavy machine bay as a Diesel-electric locomotive machine shop and for the present to use one of the three tracks in the erecting shop for such locomotives. This bay was partitioned off from the erecting shop in order to have an especially clean shop for the Diesel-electric repairs. The machines located in this area were moved to other parts of the shop and new machinery and equipment installed. Separate rooms were partitioned off from this shop for Diesel engine test room, office, store and cleaning department.

Nature of the Old Lighting

The entire shop had been lighted previously with incandescent lamps, in porcelain enameled reflectors giving from 3 to 5 foot-

Lighting in the erecting shop

candles on the horizontal working plane. As three of the four bays were equipped with traveling cranes, the lighting fixtures were hung at the roof truss level. In connection with the shop conversion, it was decided to modernize the entire lighting system of the shop.

Electric power is generated locally at the shop power plant and the kilowatt capacity available for lighting was limited. In order to obtain the best lighting possible without installing new underground feeders across the entire shop or new longitudinal feeders overhead or making the demand too high, it was decided to light the building with type "H" mercury lamps but with a small percentage of incandescent lamps in each bay to furnish a certain amount of white light and to protect against all of the lights going out in case of a momentary dip in voltage. Wartime restrictions precluded even the consideration of fluorescent lights for the overhead fixtures.

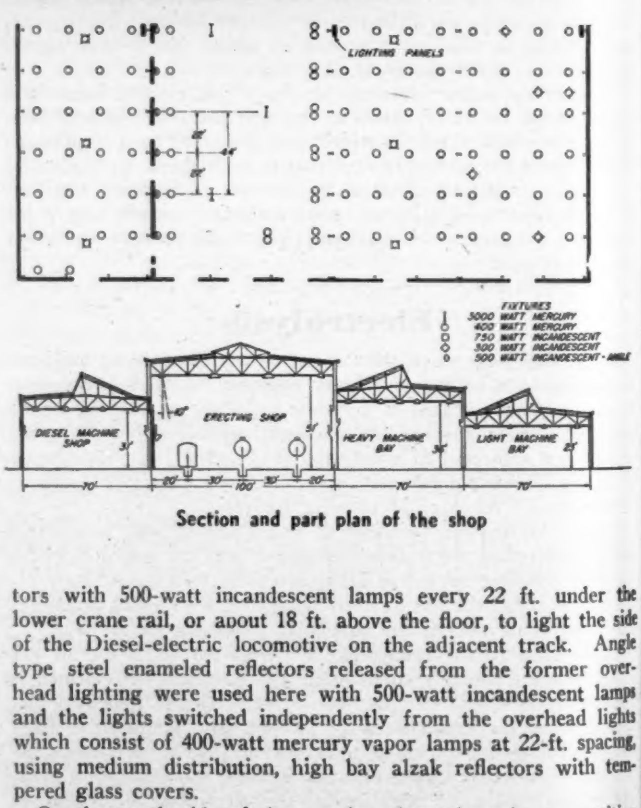
In the light machine bay, the fixture spacing was not changed but the fixtures were suspended from the roof truss instead of from the roof timbers. One hundred of the one hundred and forty-two 300-watt incandescent fixtures were replaced with one hundred fourteen 400-watt low bay mercury fixtures with prismatic glass reflectors.

In each of the other machine bays, the three rows of 500-watt fixtures on 27 ft. 4 in. centers were replaced with four rows of 400-watt mercury fixtures on 22 ft. centers and, in addition, a row of 750-watt incandescent fixtures on 54 ft. 8 in. centers over the center aisle. High bay prismatic glass reflectors were used for the 400-watt mercury fixtures in these bays.

Large Mercury Vapor Lamps

In the erecting shop with its three longitudinal tracks, the lighting was first laid out on the general basis of maintaining the four rows of fixtures, using twin 400-watt mercury vapor lamps in each row and spacing them 22 ft. apart after a test. However, it was decided to use 3,000-watt mercury lamps for the two center rows, staggering them and locating them 88 ft. apart. With the 51-ft. mounting height and the fixtures 35 ft. from the sides of this bay, these 3,000-watt lamps in porcelain enameled reflectors give very good distribution for erecting shop operation. Reflectors with medium distribution, instead of smaller units which gave a wide spread, were thought to be better fitted to light the space between the outer tracks and the sides of the bay.

As the south side was partitioned off from the new Diesel machine shop, it received no light from the side, either natural or artificial; hence it was decided to mount a row of angle reflectors with 500-watt incandescent lamps every 22 ft. under the lower crane rail, or about 18 ft. above the floor, to light the side of the Diesel-electric locomotive on the adjacent track. Angle type steel enameled reflectors released from the former overhead lighting were used here with 500-watt incandescent lamps and the lights switched independently from the overhead lights which consist of 400-watt mercury vapor lamps at 22-ft. spacing, using medium distribution, high bay alzak reflectors with tempered glass covers.



Section and part plan of the shop

On the north side of the erecting shop, there is no partition and twin 400-watt mercury vapor lights are used every 22 ft.

Local Lights Provided

A general illumination of around 20 footcandles on the horizontal plane was planned and obtained for the entire shop. In addition, there are available local lights at a number of machines where high precision work is done, and fluorescent floor stands for use over the benches in the electric shop, etc.

The two rows of 3,000-watt reflectors down the center of the erecting shop have sufficient spread to give good lighting on the vertical plane on the sides of locomotives in the shop, and it is thought that they are better in this respect than a larger num-

Lighting in the Diesel machine shop

ber of 400-watt concentrating reflectors would be and their initial cost and maintenance are lower.

There had been complaint of poor lighting under the traveling cranes, consequently all cranes were equipped with lights underneath, using spring suspended prismatic glass reflector crane lights.

Intensity of Illumination

The following illumination was obtained on a 36-in. horizontal plane, the tests being made with a Weston sight meter with Viscor filter, after the lights had been in service for a few weeks:

Location	Average Footcandles
Light machine bay (mercury vapor lights)	16
North heavy machine bay (mercury vapor lights)	22
Diesel machine bay (mercury vapor lights)	19
Erecting Bay	
Between tracks	20
North side between track and columns	19
South side between track and columns	17

Power Distribution

Electricity is generated in the shop plant at 450 volts, three phase, 50 cycles and, with the former distributing system, each third of the shop had a separate transformer, reducing the voltage to 115/230 volts, three wire, with lighting panels on the outside wall of the light machine bay and on columns on each side of the erecting shop. Three-wire feeders were installed to the latter panels in conduit under the shop floor. In order to provide additional capacity, these underground feeders were cut over to 460 volts, three phase, and dry type transformers installed, wired in star, at each side of the erecting shop, the panels there being replaced with 4-wire, 115-volt panels except for the 3,000-watt mercury fixtures which are controlled individually by separate circuit breakers at 460 volts, the circuit breaker panels being located beside the others at each side of the erecting shop. As the Diesel-electric machine shop was partitioned off from the erecting shop, separate circuit breaker panels were installed for that shop.

Three-wire, 115/230-volt distribution was retained for the light machine bay but with new circuit breaker panels and single lamp transformers on the 400-watt mercury vapor fixtures. Tu-lamp transformers were used so far as possible on the 400-watt mercury vapor fixtures in the rest of the shop. As the overhead longitudinal runs of circuit wiring were all three-wire, and as 115 volts was required for miscellaneous lighting and for extension cords, this voltage was retained for all of the circuits feeding the 400-watt mercury vapor lamps.

3,000-Watt Mercury Vapor Lamps for High Bay Lighting

The last part of the report describes an assembly shop of the General Electric Company, at Philadelphia, Pa., in which 3,000-watt mercury lamps, in open-end reflectors, mounted 40 ft. 6 in. above the floor, are used to produce maintained illumination of approximately 60 footcandles.

The report is signed by E. R. Ale, (*chairman*), office of electrical engineer, Pennsylvania; L. S. Billau, (*vice-chairman*), electrical engineer, Baltimore & Ohio; J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy; H. A. Hudson, signal and electrical superintendent, Southern; S. D. Kutner, assistant engineer, New York Central; G. L. Sealey, assistant engineer, Reading; C. A. Williamson, electrical engineer, Texas & New Orleans.

Discussion

Consideration of the report on illumination raised the question of how many germicidal lamps would be required to assure satisfactory air conditions in a wash room, 10 ft. square. A manufacturers' representative stated that two 30-watt lamps would be sufficient, i.e., one for each 50 sq. ft. of floor area.

At the request of the committee, H. H. Helmbright, railway lighting division, General Electric Company, prepared and presented a paper on lighting which was well illustrated with lantern slides. The following is an abstract of Mr. Helmbright's paper:

World War II definitely helped to establish lighting as a must and a practically indispensable tool of industry. One can well imagine the handicaps that the aviation industry would have been burdened with had they not been provided with adequate lighting to permit 24 hour production. Acres of manufacturing areas in this industry alone were equipped with modern lighting systems, providing footcandle levels of 50 to 100, and in some instances, 200 or more footcandles on the working plane. In fact, World War II might easily have been lost without good lighting in those industries essential to successful prosecution of the war effort.

The fluorescent lamp was made available in 1938, and with its 4 to 1 efficiency advantage as a producer of light over the

conventional filament type lamp enabled industry to save a considerable amount of power and at the same time supply adequate lighting.

Since the year 1936, the U. S. lighting load (including filament and fluorescent lamps) has increased better than two and one-half times. Due to the improved efficiency of fluorescent lamps, the light output throughout the country has increased more than 3 to 1. This is the only mature industry which has shown such growth over a similar ten year period. Only during the past several years have the railroads of the country decided to take lighting seriously.

One can enter almost any of the country's roundhouses or other railroad shops and still find workmen trying to go about the task of seeing by using that ancient, smoky, oil soaked torch In these days, such practice doesn't indicate progress such as found in other fields. Furthermore, where railroad facilities are provided with lighting systems, very little effort is directed toward the cleaning or maintenance of the lamps and equipment. This, in general, can be said of railroad lighting installations in locations other than shops, such as stations, offices, etc. As a result, the greater portion of the original investment is lost. The housekeeping has not been very good.

However, some of our railroads are beginning to take good lighting seriously. Your attention is directed to photographs shown in this year'se annual report of your Committee on Illumination. Real progress and the sense of appreciation of good lighting are indicated.

Shortage of labor and material at present is holding up production, but you can look forward to new and better light sources. The available types of fluorescent lamps will include those which start instantly without the usual lag required to preheat the cathodes. Fluorescent lamps in circular form to be known as circline lamps will be produced.

New colors of phosphors that are more suitable and pleasing will become available. The 4500 white fluorescent lamp is now being supplied in limited quantities. In general, it can be expected to replace the present 3500 deg. white lamp. Its color is between the 3500 deg. white and the daylight lamp.

The relatively new line of lamps known as "slimline" will come into greater use and will be available in 42, 64, 72 and 96 inch lengths. These lamps are adaptable to continuous row and cove lighting and other instances, where the architecture of station interiors or similiar locations, requires a long unbroken light source and where space is limited. They are instant starting and can be operated at either 100 or 200 milliamperes.

A development announced during the war period is the 3,000-watt mercury lamp, better known as the H-9. This lamp, delivering approximately 120,000 lumens, is particularly adapted to large area, high bay locations such as erecting shops and other similar locations.

In time to come, a large variety of fluorescent lighting fixtures incorporating developments resulting from war time efforts will be produced. Both plastics and perforated metal will play a large part in fixture fabrication. This means less weight and possible lower costs, as well as a more attractive fixture.

Germicidal lamps developed just prior to the war fit into the picture of the future. The railroads will eventually use them in treating the air in station areas, particularly in rest rooms, washrooms and waiting rooms. Developments are now under way to adapt them to passenger car air conditioning systems and water coolers. They are available at the present time in limited quantities in several wattages. In general, they operate from the same auxiliary equipment used for fluorescent lamps of corresponding wattage. Some manufacturers are about to announce a combination fluorescent and germicidal fixture.

Mr. Helmbright then presented the slides and concluded by saying, "You pay for good lighting whether you buy it or not."

Protective Devices and Safety Rules

The committee reported on all of its three assignments. These had to do, respectively, with (1) prevention of electric sparks where inflammable materials are loaded, (2) special protection where there is evidence of stray electric currents and (3) provisions required where wire lines pass over oil and gas storage and handling facilities. Work on the first two assignments was limited to revision of the Manual, while that on the third comprises recommended practice that is offered for adoption and publication in the Manual. The recommendations for this third condition are as follows:

General—1. Where any wire line is within 20 ft. of the tank opening the use of a metallic gauging rod is prohibited.

Location of Tanks or Tank Cars—1. Wherever possible, stationary tanks shall not be located under or near any wire lines.

2. When the contents are being gauged or transferred, tank cars, wherever possible, shall not be located under or near any wire lines.

3. Where tanks (or tank cars) the contents of which are being gauged or transferred, are necessarily located under or near wire lines having a span length of 150 ft. or less, and operating at a voltage not exceeding 550 volts between conductors, the following rules shall be observed: (a) Where wire lines pass overhead, there shall be a minimum vertical clearance of 8 ft. at 60 deg. F. between the wires and the tank. (b) Where wire lines pass nearby and do not have the minimum vertical clearance specified above in paragraph 3-a, there shall be a minimum horizontal clearance of 8 ft. between the wire lines and the tank. (c) Openings in tanks shall be at least 6 ft. distant horizontally from any overhead wire lines.

4. Where tanks (or tank cars) the contents of which are being gauged or transferred, are located under or near wire lines having a span length in excess of 150 ft. or operating at a voltage in excess of 550 volts between conductors, it is recommended that special studies be made by qualified persons and such additional clearance provided as necessary to give adequate protection.

The report is signed by J. E. Gardner, (*chairman*), electrical engineer, Chicago, Burlington & Quincy; J. M. Trissal, (*vice-chairman*), superintendent communication and electrical engineer, Illinois Central; D. M. Burckett, electrical engineer, Boston & Maine; H. F. Finnemore, chief electrical engineer, Canadian National; S. W. Law, signal engineer, Northern Pacific; Paul Lebenbaum, electrical engineer, Southern Pacific; E. G. Stradling, superintendent telegraph and signals, Chicago, Indianapolis & Louisville; S. M. Viele, assistant engineer, office of electrical engineer, Pennsylvania; R. P. Winton, welding engineer, Norfolk & Western.

Track and Third-Rail Bonds

With relation to the application of welded type bonds, and injury to bonds due to rail-end welding and methods of prevention, the committee offers the following information, based on the experience of a number of railroads:

1. Less damage to bonds is caused by building up rail ends by electric welding than when gas is used, because less heat is generated and because the arc can be more readily controlled.

2. The wet asbestos pack constitutes effective protection, but is seldom used.

3. In the end, removal of the bond, if of the signal type, is the only certain method of preventing injury.

For the purpose of providing rail-head pin-type bonds and track connectors for the bonding of track rails (where applicable) in electrically operated systems, the Electrical Section has adopted, by reference, the mechanically applied rail-head type bond covered by Signal Section Specification 179-45, except that Paragraph 1, Purpose, thereof shall read:

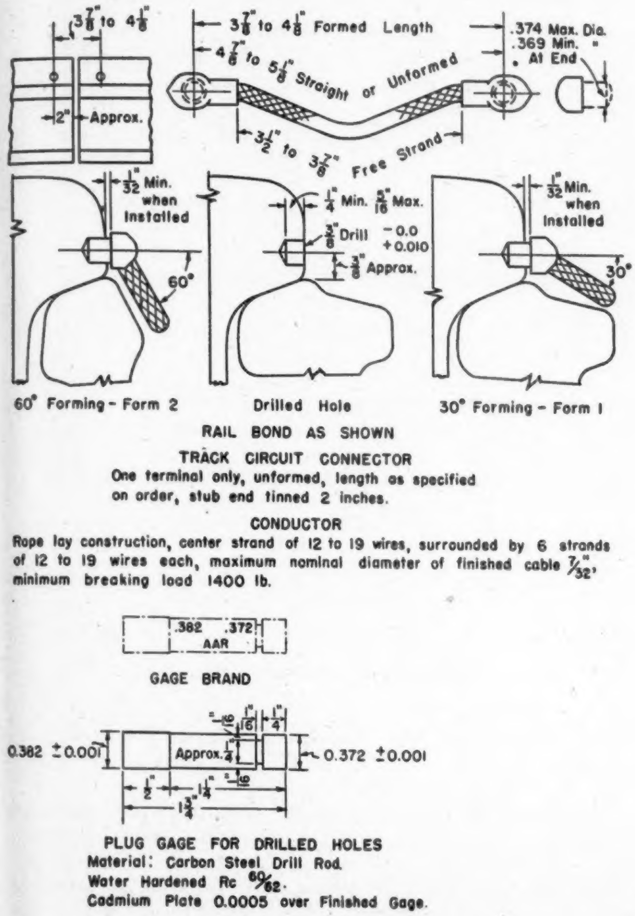
This specification is for the purpose of providing mechanically applied rail-head pin-type bonds and track connectors for track circuits carrying return propulsion current.

Also that references to Drawing 1048 in Paragraph 2 and Paragraph 5, shall be deleted and replaced by reference to the Electrical Section drawing which is presented with the report.

The report is signed by Paul Lebenbaum, (*chairman*), electrical engineer, Southern Pacific; A. B. Costic, (*vice-chairman*), electrical engineer, Delaware, Lackawanna & Western; W. P. Bovard, manager, Rail Bond Division, Ohio Brass Company; H. H. Febrey, supervisor, Specialty Sales, American Steel & Wire Company; C. G. Lovell, assistant electrical engineer, Chicago, Milwaukee, St. Paul & Pacific; H. G. McMillan, assistant engineer, New York Central; C. R. Wadham, assistant engineer, Illinois Central; L. C. Walters, assistant to vice-president, signal and electrical, Southern; R. C. Welsh, foreman, office of electrical Engineer, Pennsylvania.

Discussion

It was pointed out that the committee's recommendation of pin-type bonds called for drilling holes at equal distances from the center of the joint. On the New Haven, these holes are drilled asymmetrically, permitting the use, if desired, of two



Details of rail-head pin-type bond

overlapping bonds of equal length. When the rails are drilled for only one bond, one of the holes is nearer to the end of the rail than the other. This was accepted as good practice. The committee was given sanction to revise the drawing to provide for double bonding.

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Design of Indoor and Outdoor Substations

The work of the committee has been concerned essentially with its assignment 2(b) on circuit breakers, collaborating with the Electrical Section, Mechanical Division. It consists of a brief report by H. F. Brown, engineer electric traction, New York, New Haven & Hartford, on recent circuit breaker and protective relay changes on the New Haven electrification. It is reproduced in full here.

In 1914, when the New York, New Haven & Hartford Railroad put into effect the three-wire system of power distribution for its 11/22 kv. electrification system between New York and New Haven, Conn., it had in operation over 200 separate sections of through trolley and feeder circuits protected at each end by approximately 450 specially designed outdoor circuit breakers, mounted on the catenary anchor bridges. The breakers had a rupturing capacity of about 3,000 amp. at 11,000 volts, and the associated relay system was so designed that no breaker was opened under fault conditions until the fault current had been reduced to a safe rupturing value by the insertion of resistance in series with the line at the power supply points. The insertion of these resistances, which were of value several times the maximum line impedance, had the effect of reducing the current in all circuits but the faulted circuit to uniform values below the pick-up setting of the relays, so that all relays that picked up on a fault, except those connected to the two breakers directly supplying the faulted circuit, dropped back during the interval between the instant of the fault and the energization of a common trip power circuit from the power station to all switching stations. This protective scheme was outlined in the report of the Committee on Design of Indoor and Outdoor Substations of the Electrical Section, A.A.R., for 1932 (pages 81-86, inclusive).

The growth of the system, increased loads, additional power supply, and heavier motive power, indicated as far back as 1936 the necessity of larger capacity circuit breakers and faster fault clearing. The matter of securing larger capacity single-pole breakers was investigated and it was found that new breakers of standard design of the capacity required could not be located on the switching structures as originally designed, and that major redesign of switching stations, involving considerable expense, was indicated if the new type breakers were to be used. A great advancement in the art of circuit breaker design had been made since the installation of the original breakers, and the matter of applying some of the design improvements to the existing breakers to increase their rupturing capacity was taken up with the manufacturer.

A calculating board study was first made in 1937 to determine the maximum system symmetrical short circuit, based on the then existing power supply, plus some additional future generation. This was found to be 16,000 and 17,000 amps. Two breakers were returned to the manufacturer for experimental tests, and various design improvements were added, and tested in the manufacturers' high-power laboratory.

The principal changes made were:

- Deion grid contacts
- New tanks
- Improved operating mechanism design
- Segregation of auxiliary switches, outside of circuit breaker.
- D.c. solenoid operation instead of a.c. solenoid
- Improved venting, and catching of thrown-out oil
- Spring mounting of breaker
- Substitution of structural steel supporting frames for cast iron frames

During the testing before the final design was complete one breaker was destroyed in the test laboratory.

The breaker as finally redesigned amply met the rupturing requirements, and the total fault clearing time was reduced to between 3 and 4 cycles, as compared with 16-18 cycles delay with the original scheme. These changes cost nearly 1.5 times the original 1913 cost, per breaker. The rehabilitation cost, however, was about 40 per cent of the cost of new breakers, and they could be returned to their former places in the switching station without additional major expense.

A program was then set up which allowed a complete switching station to be taken out of service, while the breakers were taken down and rebuilt by railroad maintenance forces. Storage batteries at each station replaced the former a.c. tripping and closing power.

Individual instantaneous over-current relays of modern design were substituted for the old relays as each switching station was rehabilitated, with a local master time-delay relay which was used first to coordinate the time of tripping of the new breakers with the old breakers at the switching station next beyond, which was still on the original time-delay-resistance insertion scheme.

When enough stations had been changed (there are 22 in all, with revised breakers), the resistance insertion scheme was discontinued and all trolley and feeder circuit breaker relays were made instantaneous. The bus and transformer differential protection was left on the local time delay at each station.

The use of instantaneous relays necessitated further calculating board studies, which were made in 1939 and 1942, and by means of which was determined the amount of current delivered to a fault at each switching station bus from either direction by trolleys and feeders and from the balancing transformers. From these values were determined the individual relay settings for all expected types of faults, such as faults near switching station, stub-end feed faults at end of section, faults at the center of a section fed from two adjacent stations, etc. There are enough parallel circuits between stations so that all of these various kinds

of faults can be taken care of by instantaneous relays, with proper settings. This makes the system one of the largest in the country protected by instantaneous relays.

The installation of new breakers and the new relay scheme has been progressing slowly during the war, and is now practically complete. It is operating with a very high degree of selectivity.

The report also calls attention to the revision of the American Standard for Automatic Station Control, Supervisory, and Telemetering Equipments which was received by the Sectional Committee on Power Switchgear C37 from the American Institute of Electrical Engineers and approved December 11, 1945. This has been issued as an American Standard bearing the designation of C37.2-1945.

The report is signed by H. E. Preston, (*chairman*), power supervisor, Illinois Central; S. R. Negley, (vice-chairman), electrical engineer, Reading; J. C. Fox, electrical engineer, Virginian; C. J. McCarthy, assistant engineer, New York Central; S. V. Smith, foreman, office of electrical engineer, Pennsylvania; P. E. Snead, assistant engineer, Southern; H. P. Wright, assistant electrical engineer, Baltimore and Ohio.

Electric Heating

Subjects covered by the Committee on Electric Heating and Welding include electric heaters for track switches, electric heating for wayside water stations, and the protection of exposed water lines by electric heating.

A canvas of manufacturers developed the information that all heaters are made on special order in lengths of 10 to 48 ft., in 2-ft. increments. The investigation applies to straight tubular type heaters only and further study will be necessary if the "hairpin" and "ballast" types are to be included.

The data available indicated that the length was not especially critical and that 5-ft. increments would be practicable. For requirements of more than 25 ft., two heaters end to end (connected parallel) could be used. The standardized lengths would permit a manufacturer to stock heaters to be shipped and handled as straight, uncoiled units. The lower cost of two 25-ft. units, as compared to one 50-ft. unit, would apparently offset the cost of an additional junction box. Standardization on a few sizes is expected to reduce costs. This would not prevent any railroad from purchasing heaters of any length which the manufacturer could supply.

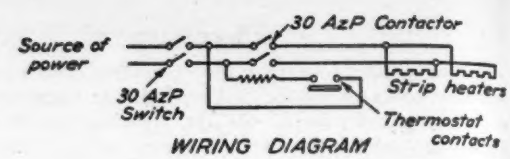
A wattage value has been chosen which, it is believed, will care for the usual requirements. In view of the demand charge which is generally a considerable factor in the electric power bill, it is doubtful if heating capacity sufficient for the unusual condition which may occur in a few locations only once in probably 10 years is economically justified. Present values are from 250 to 1,000 watts per foot. The preferred method of obtaining a change in heating values is to change the voltage by means of transformer taps. The values chosen will give the following results:

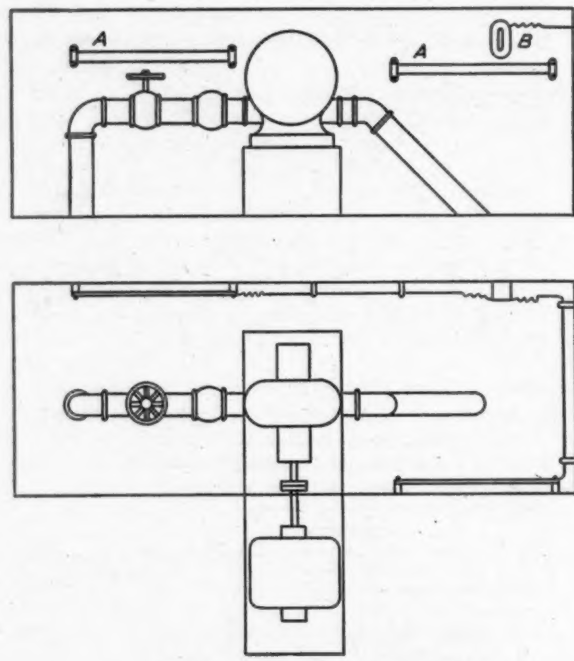
Secondary Voltage	Per cent Voltage	Per cent Current	Per cent Heat Produced	Watts Per Ft.
264	110	110	121	425
240	100	100	100	351
170	71	71	50	176

Proposed specifications for tubular type electric heaters are included in the report. The committee has made a study of heating for wayside water stations and has concluded that automatically controlled electric heat offers the best solution. Not only the pump itself but control lines and control equipment such as altitude gauges, etc., must be protected in temperatures of zero and below.

One installation of this type, using space heaters, was studied by the committee and consisted of the following:

The pump is in a brick pump house located at the shore line of an artificial lake. A dam at one side of the lake controls the maximum height of the water level, which in winter is maintained close to the floor level of the pump house. Thus there is no opportunity for the suction line to freeze as it is about 4 ft. under water. The pump house has a concrete floor with the suction line on a 45-deg. angle from the pump and extending about 4 ft. below the floor, then extending on a lesser angle into and towards the bottom of the lake. The discharge line leaves the pump and is buried about 4 ft. below the floor of the pump house so as to avoid any chance of freezing.





Sketch showing the heater installation

The installation consists of a small 150 gal. per min. horizontal centrifugal pump direct connected by a flexible coupling to a 5-hp., 3-phase, 60-cycle, 220-volt motor.

To protect the pump and piping above the floor from freezing, a wooden box lined with sheet asbestos and having a hinged cover was built as shown in the sketch, the connecting shaft projecting through the side of the box and the motor mounted outside the box. The pump and motor both rest on a concrete foundation. A Westinghouse thermostat control type AA, (220-volt, single-phase, 60-cycle) was installed and set to operate at 31 deg. minimum and cut out at 40 deg. This control is connected to a Square D, 2-pole, 20-amp. fused safety switch mounted on the wall of the house, the wiring being in conduit from the box to the Square D switch.

Also connected to the thermostat control are two Westinghouse electric space heaters, No. 449-104 rated at 1,000 watts each at 220 volts. These heaters are of the strip type and are mounted on A.A.R. porcelain terminal blocks, No. 1077A. The wiring to the heaters is supported on the sides of the box by means of porcelain insulated screw eyes.

On the sketch the heaters are indicated by AA and the thermostat by B. The lid of the box is raised for summer operation and the Square D switch left open. This heating equipment, including box, Square D switch, thermostat, heaters and wiring, costs approximately $34 for material.

The latter part of the report prepared by Anatole R. Gruehr, division engineer, electrical engineering department, Consolidated Edison Company of New York, outlines a method of maintaining the temperature in a pipe above freezing by passing alternating current through the pipe. A 50 kva., 2,200-220-110-volt transformer with its primary connected to 220 volts was used to supply the necessary low voltage power.

The report is signed by C. A. Williamson, (*chairman*), electrical engineer, Texas & New Orleans; J. C. McElree, (*vice-chairman*), electrical engineer, Missouri Pacific; G. K. Shands, general foreman, Virginian; E. G. Stradling, superintendent telegraph and signals, Chicago, Indianapolis & Louisville; E. T. Wiltsee, electrical inspector, Illinois Central; R. P. Winton, welding engineer, Norfolk & Western.

Electrical Section, Mechanical Division

Group holds busy two-day session which indicates that future electrical railroad applications will include many new ramifications

THE 1946 Annual Meeting of the Electrical Section, Mechanical Division, Association of American Railroads, was called to order at 9:30 a.m., October 23, 1946, by Chairman L. J. Verbarg, air conditioning engineer, Missouri Pacific. He reviewed recent railroad history affecting the electrical department, with emphasis on work delayed by war, and developments made possible by basic engineering improvements created under pressure of war. He also announced the election of the following officers:

Chairman: G. E. Hauss, electrical supervisor, Baltimore and Ohio.

First Vice Chairman: J. E. Gardner, electrical engineer, Chicago, Burlington and Quincy.

Second Vice Chairman: L. S. Billau, electrical engineer, Baltimore and Ohio.

Secretary: J. A. Andreucetti, chief electrical engineer, Chicago & North Western.

Committee of Direction: M. A. Pinney, assistant electrical engineer, Pennsylvania; L. C. Bowes, electrical engineer, Chicago, Rock Island & Pacific.

Secretary J. A. Andreucitti reported on Association work done by committees since the last meeting, which was held in 1941.

Automotive and Electric Rolling Stock

Oil Reclamation

An investigation made by a subcommittee on Diesel engine lubricating oil reclamation, disclosed that out of a total of 42 railroads, 21 make a practice of rerefining crankcase drainings, 7 recondition the drainings, and 13 use the drainings for other lubricating purposes and in one case they are discarded. Further study of the subject is recommended.

Reclamation of Engine Parts

The subcommittee reporting on the reclamation and reconditioning of Diesel engine parts recognizes the importance of retiring some of the older types of locomotives which require an excessive amount of parts reclamation and which cannot readily be adapted to standardized maintenance. The report describes the reconditioning of wearing parts which are being regularly reclaimed by generally accepted methods.

Grinding is recommened for reconditioning of crankshafts, with sizes for crankshaft pins and journals set up in steps of 1/32 in. when regrinding. Building up of crankshafts by the metal spray process is not recommended as a general practice.

Repair of crankcases by welding is recommended except in cases where there is any possible chance of distortion having effect on main bearing alignment.

Use of over and undersize pistons is no longer considered practicable, and chrome plating is recommended for resizing cylinders in which the increase in diameter after truing is not over .03 in.

Grinding and porous chrome plating of cylinders is recommended.

The maintenance of Diesel engine pistons has been found to be quite different for those made of cast iron as compared with aluminum alloy. The former sometimes develops cracks and are scrapped before appreciable wear takes place. The latter, on the other hand, are quite free from cracking but often develop a rather rapid wear of the ring grooves which limits the useful life.

It has been proved that aluminum pistons, other than liquid cooled, can be reclaimed by machining out the ring groove belt and welding this in again with aluminum by the acetylene process and recutting standard ring grooves after the piston has been heat-treated. A repetition of this procedure on the same piston is not recommended.

The generally accepted procedure for reconditioning or reclaiming cylinder heads amounts to regrinding valve seats, application of new valve guides, testing of the water spaces and welding any leaks or cracks which may have developed. These processes are carried out on heads made of either aluminum or cast iron.

In the regrinding of valve seats, it is recommended that a high speed grinder, which is especially designed for this work, be used. Accurately made pilots should be appled to the valve guides to give proper support and alignment of the grind wheel when this work is being done.

A special provision should be made to keep the valve seats within manufacturers' standards.

The report also includes a recommended procedure for welding up cast-iron and aluminum cylinder heads.

Valve stems are reclaimed by turning down to undersize, then building up to standard size by chrome plating. The chrome plating is much harder than the original valve material and this method has not been found very successful. A repetition of reclaiming the same valve by the above method is not recommended.

Storage Batteries and Compartments

Recommended sizes of batteries and compartments are offered for inclusion in the manual, in substance as follows:

For all future Diesel-electric locomotives in switching service using Diesel engines of 600 hp. and larger, storage batteries having nominal capacity not less than 260-amp. hrs. at the 8-hr. rate with 1.250 specific gravity are recommended.

For all future Diesel-electric locomotives in road service using Diesel engines from 600 hp. to at least 1,500 hp. storage batteries having nominal capacity of not less than 420-amp. hrs. at the 8-hr. rate with 1.250 specific gravity are recommended.

Batteries should have at least 1½ in. operating range of electrolyte level. Inter-cell connections should be burned on and inter-tray connections should be insulated flexible copper cable with lead-plated lugs, bolts and nuts.

Because of variations of builders' designs, it is considered impracticable to specify width and depth of battery boxes, but it is recommended that those on both switching and road locomotives be large enough for a 420-amp. hr. battery. The height of boxes served from the side should be at least 22 in. and preferably 25 in. When served from the top, the height may be reduced to 19¾ in. if the service opening is large enough to permit free access to all cells.

The boxes should have outside ventilation, should drain freely and be easily accessible for washing.

Transformer for Standby Lighting

To prevent drain on the storage battery while road Diesel locomotives are in shops or laying over at engine terminals, it has been found very desirable practice to use outside electric power for supplying the lighting on the locomotive rather than using the storage battery. This is accomplished by installing permanently on the locomotive a 1½-kva., air-cooled transformer with lighting circuits so arranged that by means of a double-throw switch the lighting circuits may be connected either to the power supply circuit on the locomotive or to the transformer.

It is recommended that the transformer have two secondary voltage connections which will permit using the same transformer on locomotives with the 75-volt lighting system as well as those with the 60-volt lighting system where lamp regulators are employed, and thus avoid the necessity of manufacturing two separate lines of transformers.

The outside connection is to be made through two receptacles located under the cab frame on each side of the locomotive. The report covers specifications for the transformer and its installation.

New Developments

A sub-committee on new developments has included in the report brief descriptions of the following recently developed equipment: 1,500-hp. single-engined locomotive units developed respectively by the American Locomotive Company, The Electro-Motive Division of the General Motors Corporation and the Ingalls Shipbuilding Corporation; a 3,000-hp. two-engined unit built by the Baldwin Locomotive Works; a 2,000-hp., single-engined unit produced by Fairbanks-Morse and Company; electrically driven auxiliaries developed by four locomotive manufacturers which improve control and eliminate belts and a new 3,000-lb. steam generator made by the Vapor Car Heating Company.

Overhauling Diesel Motors and Generators

Sub-Committee No. 5 offers as information a list of shop facilities and a procedure schedule for overhauling electrical equipment of Diesel-electric locomotives. It is abstracted in the following:

The repair and overhaul of generators and traction motors requires a shop which is well illuminated, having ample floor space for arranging the shop equipment in proper order and sufficient head room for installation of overhead cranes. A loading platform should be available in or adjacent to the shop with necessary crane service for loading and unloading.

The shop equipment should consist of jib and overhead travelling cranes, wash rack, cleaning booths and tanks, paint-spray booth, various size presses, lathes and drill presses, pinion and miscellaneous pullers, dynamic balancer, baking ovens, undercutting machines, commutator grinders, vacuum impregnator, banding machine, electric brazing machine, soldering pots, coil winder and former, test stands equipped for running in and testing out motors and generators, dipping tanks, buffers, miscellaneous hand tools, meters and electrical testing instruments, supply and storage cupboards, armature stands and racks, work benches, electric and acetylene welding equipment, and equipment for magnetic inspection.

Traction motors and generators needing inspection, cleaning and repair require a preliminary inspection prior to dismantling to determine general condition of frames, heads, nose support, wear plates, frame covers, brushes, bushings and terminals, gear-case support, axle-bearing supports, cables, armature bearings and commutator.

The data covering this inspection should be recorded in suitable manner to be utilized for making repairs and for future reference. When the above preliminary inspection is completed the motor or generator should be completely dismantled and the various parts cleaned.

Armatures which require rewinding must have the old coils removed and cores thoroughly cleaned and inspected for defects before new coils are applied.

Armatures which do not require rewinding or lifting of coils for renewal should be inspected for loose banding wire and wedges and new bands and wedges applied if needed.

The proper cleaning of cores to be rewound goes beyond removing the old coils and scraping out the slots. Grease must be removed, old paint must be stripped, vent ducts cleaned, and the outer surfaces of laminations cleaned. One effective method of accomplishing these aims is by the use of hot vapor cleaning—a process termed "degreasing". Facilities for degreasing were described in the March, 1944, issue of *Railway Mechanical Engineer*, page 138.

Preparation of Core

Core laminations of armatures which have failed are frequently found to have been damaged by arcing in slots between conductors and core. Also, the outer surface of the core may have been defaced by pieces of conductors or bands being caught between armatures and pole faces. Where the damage is severe, new core-stacking may be necessary.

A very effective method of removing the fused surfaces in the core slots is to grind them out with a high-speed, portable tool. On armatures having core bands, it is often desirable to true up the banding grooves before rewinding. An often-used practice for accomplishing this is to drive a hard-maple block into each slot, filling to the bottom of the band groove and then with the armature turning in a lathe, true up burred-over laminations at the edges of the band groove, taking light cuts with a high-speed, tool-post grinder.

The general practice in the magnetic inspection of traction armature shafts is to apply the test to exposed surfaces without pressing the shaft from the armature core. Many fatigue cracks are detected on the tapered pinion fit adjacent to the bearing fit.

Fatigue cracks in armature shafts are not limited to the zone between the bearing and pinion fit. If a complete check is wanted, the shaft must be removed and tested over its full length.

Commutators

When a commutator shows evidence of having been very hot, it is good practice to test the hardness of the bars and to replace those which are soft. It is also important on commutators of high peripheral speed that the amount of bar stock depthwise be checked so that there will be no danger of the bar bowing outward because of centrifugal forces.

After the winding is removed from the armature, the coil slots are cleaned for the new coil leads, all burrs and fins are removed and commutator is given a ground test.

If the V-rings are loose or have been disturbed, the commutator should be seasoned before again placing the armature in service.

As little copper as possible should be removed from the commutator in turning and truing. The point of the tool should be rounded so that a smooth surface results. Final surfacing can be done with a stationary stone mounted in the tool post with the armature running at a high speed. A final polish may be given with a hand stone or very fine sandpaper. The commutator should be true within .001 inches for any high-speed motor. Where greater precision is wanted the commutator may be ground with a carborundum wheel, while the armature is rotated at full speed in its own bearings, in a special grinding rig.

The commutator mica segments should be undercut and after undercutting, the rough corners of the copper bars must be removed. After the commutator has been finished, it should be thoroughly cleaned and given a ground test.

The protection of the outside surface of the V-ring mica that projects beyond the commutator can be accomplished by applying a coat of shellac, running over this a single layer of Fiberglas braid, and coating repeatedly with red enamel, sandpapering between coats. This will result in a very smooth surface which will minimize the collection of dust and oil.

Armature Windings

All modern traction armature windings are fabricated with Class B insulation, having a temperature rating of continuous operation at 120 deg. C. above ambient. Often, higher temperatures are reached in operation, and the best of insulating materials are strained to their limit.

The introduction of Fiberglas cloth and tapes has done much to relieve the situation and further improvement appears to be possible through the use of a heat-stable organo-silicon polymer in the form of varnishes and binders.

Equal in importance to the copper and insulation consideration is the proper installation and physical fit of the armature windings. The size of the slot portions must be held to a very close tolerance and must be correct for a tight drive fit without the necessity of adding filler materials. However, rather than have coils loose in the slot, it is preferable to use even organic fillers, though mica is the normally accepted material. A tight fitting coil may be driven into the slots with less hazard of damage by painting with an insulating varnish just prior to installation. The wet varnish serves as a lubricant and after it sets provides a bond between the coils and the core.

The point at which the coil slot section leaves the core lamination is hazardous in any winding and is even more so on railway-type armatures. The distortion from expansion and the forces caused by vibration and by inertia of the end windings concentrate combined motion and pressure between the coil and the ends of the core lamination. The slots of many armatures are recessed at their ends to accommodate a U-shaped piece of heavy paper or fabric, thus affording a cushion and method of

distributing the strain. Where resesses in the core may not have been provided, another effective method of minimizing strain concentration is to taper the core slot from 1/32 in. to zero inches for about 1/2 in. back into the core, rounding off the outer edges.

Banding

Steel wire having a tensile strength of 240,000 lb. per sq. in. is generally used for banding armatures. However, to reduce commutation voltage and band losses, a non-magnetic band wire is desirable on higher-speed traction armatures. Non-magnetic stainless-steel wire is used in preference to phosphor-bronze because of its greater tensile strength, 225,000 to 256,000 lb. per sq. in., as compared to 130,000 to 150,000 lb. per sq. in. for phosphor bronze. The band wire must be of such quality and toughness that it can be bent 180 deg. on itself without breaking.

Impregnation

Vacuum pressure impregnation is usually accepted as the best method of application for the initial treatment followed by one or two dips. The impregnating cycle may require 10 to 12 hours elapsed time, 1 hour preheat, 3 hours vacuum, 3 hours pressure, and 3 hours draining. A typical baking cycle for a 400-hp. high-speed traction armature with a core 18 in. in diameter by 16 in. long, using a high-grade synthetic varnish of the general properties shown above, is as follows:

1—Preheat in oven one hour at 250 deg. F.
2—Allow to cool to 90 deg. F. before placing in vacuum tank.
3—Bake 12 hrs. at 275 deg. F. after impregnation.
4—Bake 12 hrs. at 275 deg. F. after first dip.
5—Bake 18 at 275 deg. F. after second dip.

It is usually desirable to permit the armature to cool to approximately 100 deg. F. before each dip. This procedure gives a heavier film build-up and minimizes polmerization of the heat-reactive varnish in the tank.

At the present time there is considerable difference of opinion regarding the necessity of vacuum impregnating armatures other than those which have been re-wound, and further study is being made regarding the necessity of vacuum impregnating armatures which are not being rewound.

Dynamic Balancing

Traction drives are using higher-speed motors to obtain better efficiency and lighter weight as is evidenced by the increase in peripheral speeds from 8,000 to 12,000 ft. per minute during the past 25 years. Motors operating at these speeds must have precision-built, dynamically balanced rotating members. An unbalanced armature may destroy anti-friction bearings, break armature-coil leads, damage gearing, cause bad commutation, and in addition may have undesirable physiological effect.

Standardization of Traction Motors

The committee has met with representatives of two manufacturers to discuss the possibility of having motors of different manufacturers with interchangeable gearing. This subject will be given further consideration by the builders in the event that new motors are designed for this service.

Load Indicators

Load on the electrical equipment of a locomotive is usually indicated by ammeters, but these do not show equipment temperatures. On the other hand, thermocouples which indicate temperatures do not show load. The committee feels that some form of improved indicator is vitally needed.

The report is signed by J. P. Kivlen (*chairman*), engineer maintenance of way and equipment, Northampton & Bath; J. M. Bailey, general supervisor of Diesels, Seaboard Airline; L. S. Billau, electrical engineer, Baltimore & Ohio; T. T. Blickle, supervisor of Diesel engines, Atchison, Topeka & Santa Fe; L. W. Downey, superintendent of automotive equipment, Chicago, Rock Island & Pacific; E. J. Feasey, chief inspector of Diesel equipment, Canadian National; R. I. Fort, mechanical inspector, Illinois Central; W. S. H. Hamilton, equipment electrical engineer, New York Central; P. H. Hatch, general mechanical superintendent, New York, New Haven & Hartford; J. Stair, Jr., electrical engineer, Pennsylvania; H. C. Taylor, general Diesel supervisor, Southern; P. R. Verd, master mechanic, Elgin, Joliet and Eastern.

Discussion

Railroads have, for several years, been reclaiming Diesel engine lubricating oil, but it became evident in the discussion that the members of the Section are not satisfied that they know enough about it. Many oils contain additives which are removed in reclamation, and in some cases, an additive concentrate is mixed with reclaimed oil. The question was raised as to what kind of results are obtained when additives are not restored, and a request was passed on to the committee to include this question in its future work.

With reference to reclaiming of worn parts, one member said that most railroads are now returning parts to manufacturers and that railroads should, as quickly as possible, establish shop facilities for doing reclamation work in their own shops.

Concerning batteries, it was stated that roads which have had Diesel locomotives long enough to pass through a battery life cycle understand the difficulties arising from having a number of different batteries. It was realized that manufacturers may have difficulty in providing battery compartments on switchers as large as those recommended in the report. In addition, a request was made for as much clearance as possible for flushing requirements and for ventilation. One member, representing a railroad which employs 280 amp. hr. batteries on switchers, said he agreed with others that a larger battery is desirable for reasons of standarization, but that a road which has a large number of 280 amp. hr. batteries would not find it practicable to depart from the use of this size for the sake of standardization. Other railroads might be able to adopt the committee's recommendation.

Further discussion brought out the desirability of having standard receptacles for battery charging and a standard standby transformer since locomotives are frequently used and serviced on more than one railroad.

The opinion was expressed that the 200,000-300,000 mile motor overhaul period, suggested in the report, was in some cases unnecessarily short and that it might soon be considerably extended. This was thought to be possible, but not something that could be done quickly. Bearings were given as the usual reason for removing traction motors. It was said that if bearings could be improved, the overhaul periods may be extended. One member expressed favor of oil lubricated bearings, believing that they will materially extend overhaul periods. Another said that trucks are taken out for wheel wear and another said that his railroad is having trouble with both coils and bearings. He did not believe the overhaul figure would soon reach 300,000 miles.

It was thought by one member that if all locomotives were equipped with both voltmeters and ammeters, it might provide the enginemen with better means of avoiding conditions which might damage motors and generators.

Electric Welding

The first section of the report describes an electric arc stud welder for end-welding studs to other metallic objects. The process involves a special gun which automatically controls the arc energy generated between the stud and the plate. A special flux is inserted into one end of the stud which produces a very stable arc and dense weld metal. The arc is completely shielded by the use of a ceramic porcelain ferrule. This ferrule completely shields the arc, concentrates the arc heat and at the same time acts as a little dam or mold to hold the molten material in place. The three items in combination give a means or method by which consistently good welds may be obtained in all positions. The effect of the human element is reduced by this process and inexperienced people can perform very satisfactory stud welding operations.

The amount of current required varies, according to the size of stud being welded. A 300-amp. machine will weld studs up to and including 7/16-in. diameter. A 400-amp. machine is required to weld up to and including 1/2-in. diameter studs. Two 400-amp. machines are required in parallel to weld studs up to and including 5/8-in. diameter. Three 400-amp. machines in parallel are required to weld 3/4-in. diameter studs. The same gun is used in each case and requires only changing of the spring and

chuck on the end of the gun to one that is suitable to receive the size stud being welded. The welding period is controlled by an automatic timing device which, when once set, will automatically repeat the same weld cycle time after time.

When a gas engine driven generator is used, it is necessary to disconnect the idling device, if one is used, and run the engine at full throttle.

To make a weld, the operator merely inserts a stud in the chuck of the gun, presses it up against the plate, presses the trigger on the gun, and the weld is automatically made. It is possible for a single operator using the portable hand gun to weld anywhere from 500 to a thousand studs per day, figuring an 8-hr. work day.

A list of 22 railroad applications is given. The report states that this list is by no means complete and suggests that the railroads give careful consideration to further applications of this device.

Welding Jigs and Positioners

The report describes jigs as devices for holding assemblies while they are tack welded or completely welded and positioners which allow an assembly to be moved to any position to permit down hand welding of all connections. Concerning their value, it states that jigs and positioners have become indispensable in connection with the construction of welded assemblies and for the welding of broken and worn parts from locomotives, cars, etc.

High Speed Cutting Tips

The third section of the report describes high speed or precision Oxy-acetylene cutting tips which allow about 30 per cent greater cutting speed than standard tips. This is accomplished by a gas passage which delivers gas as a solid stream with substantially parallel sides and with little turbulence. The tips require about twice the usual gas pressure, use a little less gas per foot of cut and are intended only for machine cutting.

Electronic Tracer for Machine Cutting

The fourth and major part of the report describes an electronic tracing device for machine gas cutting. The motors which guide the cutting head are controlled by a photo-electric device which moves with the head as it follows a black and white drawing. The cutting speed is controlled by a tachometer. This method of cutting is accurate and fast, employs low cost template (drawing) which can be changed easily and which may be used any number of times.

The fifth section of the report describes "cascade" and "trailer" systems of oxygen supply. Many uses of oxygen employ manifolds, supplied by a number of oxygen cylinders,—the oxygen being piped from the manifolds to the points where it is used. The cylinders are replaced periodically as their contents are used.

The "cascade" system employs similar manifolds and cylinders, but the cylinder pressure when reduced to a predetermined value is restored periodically by a truck which carries it in liquid form, converts it to gas and pumps it into the manifold. All cylinder handling is eliminated.

With the "trailer" system the oxygen is delivered to the user by truck trailers which are made in three sizes, namely, 10,000, 20,000 and 40,000 cu. ft.

Hollow Electrode for Oxygen Cutting

The sixth section of the report discusses the potentialities of a new development in cutting cast iron which makes use of the combination of the electric arc and oxygen. In operation, the oxygen is delivered through the bore of a hollow electrode and at the same time the arc is maintained to provide a puddle of molten metal which is instantaneously oxidized and pierced by the jet of oxygen.

Tests indicate that in cutting cast iron the speed of cut is approximately three times as fast as cutting with oxy-acetylene.

The grade of cast iron does not affect the speed or ease of cutting which has been found to be a factor in cutting cast iron by the oxy-acetylene method.

In addition to being used to cut cast iron the arc-oxygen method is also being successfully used to cut chrome-nickel steel, copper-nickel steel, high alloy steels, brass, bronze and other non-ferrous metals.

The report is signed by L. E. Grant (chairman), engineer of tests, Chicago, Milwaukee, St. Paul & Pacific; A. F. Stiglmeier, general supervisor, boilers & welding, New York Central; Charles Herdy, welding foreman, Illinois Central; M. A. Herzog, chief chemist, St. Louis-San Francisco; J. S. Miller, supervisor welding, New York, New Haven & Hartford; Frank A. Longo, general boiler inspector, Southern Pacific; B. W. Covell, master welder, Northern Pacific; Robert Moran, welding supervisor, Missouri Pacific; John Hengstler, supervisor of welding, Pennsylvania; H. A. Patterson, supervisor of welding equipment, Atchison, Topeka & Santa Fe.

Discussion

The report on welding was amplified by Chairman L. I. Grant, engineer of tests, Chicago, St. Paul, Milwaukee & Pacific, with a statement which in substance was as follows: Welding is a matter of extreme importance to the railroads. Insofar as its application to repair ork is concerned, it originated on the railroads, but the railroads have not retained leadership. This is due in part to mistrust of the process handed down from the results of some early applications. If it is to be used to full advantage, many of the cut and dried applications must be replaced by engineering and the training of supervisors which will assure effective application and procedure control.

Car Electrical Equipment

Axle Generator Drives

The committee has investigated the Excel drive which has found considerable application on the Canadian Railways, but at this date only a few installations are being tested in the United States.

The original Excel drive was placed in service in 1935, driving a 3-kw. generator. This drive consisted of twin gears driving two triplex chains. These chains in turn drove a jack shaft connected to a clutch.

There are approximately 450 Excel drives of this type now in service.

It has been found that the only renewals which are necessary between overhaulings are the chains, the average life of them being approximately 100,000 miles or about twelve months. The bearings which are of bronze, last approximately 250,000 miles and are generally renewed when cars receive a general overhauling.

During the summer, the drives are lubricated with a mixture of 50 per cent car oil and 50 per cent valve oil. The use of valve oil prevents the lubrication from working out of the drive due to high temperature. In winter only car oil is used as a lubricant. The drives are oiled each trip on transcontinental trains and once a week on local trains.

The latest drives now in use are gear driven. These drives are operated on trains which average 50-55 m.p.h., but often reach a maximum speed of 80 m.p.h. It is the opinion of the Committee that any drive of this type must be capable of operating satisfactorily at train speeds of 100 m.p.h.

Two drives of the latter design operating with 7½-kw. generators have been in service a sufficient length of time to accumulate approximately 100,000 miles of service each. A third has been operated approximately 150,000 miles. No repairs have been necessary on any of the three drives.

A larger type drive now under construction is designed to operate 25 kw. generators. None of this type are yet in actual service.

The main advantage of this type of drive is that it can be applied to the axle and removed without removing the wheel.

The railroad that cooperated in this development requested a modification of this system which would give constant voltage and frequency for the operation of fan motors and other devices that are usually under the control of the lamp regulator.

An amplidyne was added to the same shaft as the inverter and a static type regulator was developed to give substantially constant voltage and frequency with a d.c. voltage variation of 85 per cent to 140 per cent of the nominal battery voltage. This equipment is known as the amplidyne booster inverter.

A d.c. starter is required for the straight variable voltage-variable frequency inverter and for the amplidyne booster inverter. The advantages of the two schemes of operation are discussed below.

Variable Voltage-Variable Frequency Inverter

The variable frequency inverter is proposed for application where fluorescent lighting and razor outlets are the only devices that require a.c. power on the car. It is not recommended where it is desired to operate relatively large condenser fan motors, evaporator fan motors, etc., from the same bus as the fluorescent lights. Electric razors have been tested on this system over the range of frequency and voltage delivered to the fluorescent lights with a d.c. voltage variation of 85 per cent to 140 per cent of nominal battery voltage.

The variable voltage-variable frequency system may be used with single lamp ballasts. This includes the slim line lamps which are finding some application on railroad cars. The use of tulamp ballasts to eliminate stroboscopic effect with this system is not recommended because the phase shift between the two lamps is obtained by capacitance. A three-phase inverter should be used not only because the inverter itself costs less than a single-phase inverter of the same capacity but also because the stroboscopic effect may be eliminated by connecting banks of lamps across the three phases that are 120 deg. apart.

Amplidyne Booster Inverters

This method of obtaining a.c. power is used when it is desired to use a.c. power for fluorescent lights, announcing systems, etc., on the same bus as induction motors that run at constant speed for evaporator and condenser fans.

The amplidyne-booster-inverter consists of an inverted converter (synchronous converter running from the d.c. side) with an amplidyne mounted on the same shaft. The amplidyne is connected in series with the inverter and bucks or boosts the voltage supplied by the axle generator or battery to maintain approximately constant a.c. voltage and frequency on the output side of the inverter. An amplidyne is used for three principal reasons:

1—To get high speed response in case an induction motor is started up when the set is loaded. An induction motor takes approximately five times normal current at about 30 or 40 per cent power factor when starting. This pulls the a.c. voltage down and if something were not done about it, the fluorescent lights connected to the same circuit would go out. The amplidyne performs as an exceedingly fast regulator and permits the starting of motors as large as one horsepower on a 5-kw. set.

2—To eliminate the losses in the field. The amplidyne control field takes about one-half watt to one watt.

3—To permit the use of a static regulator without moving parts. This device can be mounted on the machine or in some other part of the car.

As the voltage and frequency output of the amplidyne booster inverter is substantially constant, any type high power factor ballast may be used satisfactorily. Low power factor ballasts may be used, if the resulting current is within the current rating of the inverter, although there is no advantage in their use.

Special mechanical details on machines include Alemite button-head grease fittings, 8-ft. long leads. Under-car units have drain holes in covers with hole cleaning device.

One railroad has adopted a scheme utilizing the amplidyne booster inverter which contemplates all the electrical load on the car being alternating current, supplied by the amplidyne booster inverter, except the air-conditioning compressor motor, which is a dual a.c.-d.c. motor. When not plugged in on standby power, the compressor is driven by the d.c. motor. When plugged in an a.c. standby power, the compressor is driven by the a.c. motor and the battery relieved of all load, some battery charging taking place from the d.c. motor acting as a generator.

The amplidyne booster inverter is not offered for use on 32-volt battery cars. An a.c. output at 230 volts has been selected for the amplidyne booster inverters, so that their load may be transferred to plug in power at terminals; however, the manufacturer will be pleased to quote on 115-volt a.c. amplidyne booster inverters if they are required in quantity.

Spacing of Fluorescent Lamp Holders

One of the committee's assignments was to make a study of fluorescent lamp holders available and recommend method of spacing to insure proper fit and electrical contact of lamps. To develop this assignment, the committee obtained from the manufacturers, the maximum and minimum lengths of various fluorescent lamps. These are shown in a table published in the report.

Diesel-Engine-Generator Sets

At a meeting of the Car Electrical Equipment Committee held in New York on June 7, 1945, the Committee discussed at length the constantly increasing electrical loads on passenger cars, the effect of such increases on conventional direct current axle generator, storage battery types of power supply and various methods which might be adopted to successfully meet the present and future load increases.

The committee, after careful study of the assignment, unanimously reached the following conclusions:

(a) There are many objections to operating axle generators of more than 30 kw. rated capacity, which makes it desirable to consider other sources of power supply.

(b) It is not desirable to operate larger than a 30-kw. generator from one car axle. A 30 kw. generator, when operating at full load, imposes an approximate load of 62.25 hp. on cylinders of steam locomotives and 65.25 hp. at engine shaft of Diesel locomotives.

(c) That an output equivalent to 65 per cent of the continuous rated capacity of an axle generator is about all that can be realized on through passenger runs.

(d) That storage batteries larger than 1,250 amp. hr. are impractical from a first cost, life, weight and efficiency standpoint.

(e) That any increase in power required during periods when standby service is used must inevitably result in replacing present standby service facilities with heavier lines and possible redesigning of present A. A. R. standard plug and receptacle.

It was further agreed by the committee that it would be highly desirable for many reasons, if 220-volt, 3-phase, 60-cycle, alternating current could be made available for use on passenger cars. The use of alternating current demands a constant speed source of power to drive the alternator and the committee felt that the modern small Diesel engine offered a practical solution of the drive problem. With such a unit on each car, the car would be independent and capable of operating in any train with full utilization of capacity on standby.

To support is conclusion, the committee has prepared tentative specifications, for a Diesel power plant to be applied to individual passenger cars. The specifications are included in the report.

Photometers and Illumination Test Methods

On the subject of lighting measurements, the report describes various light measuring instruments including the Macbeth illuminometer, photo-electric photometers and brightness meters.

Proper methods of making lighting measurements are offered as follows:

For many tests of office lighting the average horizontal footcandles for the entire area is often desired, usually at a level of 30 in. from the floor. For car lighting tests, however, the average illumination is generally not the figure required as much as the illumination at certain set locations.

For coaches, parlor cars, etc., a figure of the illumination at the normal reading position is desired. This reading should be taken at a point at the center of the front edge of the seat on a 45 deg. plane, 33 in. above the floor, with the meter or test plate turned toward the seat and located at right angles to the center line of the seat.

Separate readings must be taken for the aisle seats and the window seats in coaches and where seats are reversible the readings should be taken with the seats in each position.

For dining cars the readings should be taken at a horizontal position on the table top and the height from the floor recorded. For two seat tables a reading should generally be taken at the center of each half of the table and for four seat tables a reading taken at the center of each quarter of the table.

Consideration must be given to the fact that the footcandles will be higher near the center of a room than at the ends and readings should be taken at all seats or at enough seats both near the center of the room and near the ends to determine this variation.

For aisles and corridors, readings of illumination should be taken on a horizontal plane at the floor level. For vestibules, readings should also be taken on a horizontal plane at the floor level, one reading being taken at the center of the vestibule, one at the center of the trap door, one at the center of the outer edge of the trap door, and one with the trap door open, at the center of the lowest step.

For postal cars, attention must be given to the requirements of

the U. S. Railway Mail Service and for dining car kitchens and pantries to the requirements of the U. S. Public Health Code.

All daylight or outside illumination must be excluded from the car and shades should be drawn.

The light output of new fluorescent lamps decreases rapidly during the first 100 hours of operation, this decrease amounting to as much as 10 per cent.

Fluorescent lamp ratings are consequently based on their light output after 100 hours of burning. This fact should be considered in specifying the illumination in new cars. Where fluorescent lamps are used, measurements of illumination should consequently not be made until at least 100 hours of operation have elapsed. In addition, the system must be lighted for at least one-half hour before measurements are made.

The voltage should be held constant at the normal voltage at the switchboard, that is at the discharge side of the lamp regulator if such is used, or the readings corrected accordingly.

When photo-electric cell type instruments are used, the car should be at a temperature above 60 deg. F. and such instruments should have their cells exposed to the approximate illumination level to be measured for at least 15 minutes before readings are taken.

When testing the illumination of a car for permanent record, careful record should be taken of the condition of the car and method of making the test.

Information should include the following:

Name or number of car and location where test is made.

Names of those making survey.

Date of survey.

Instrument used, date of last calibration and whether equipped with a color correction filter.

Identification of area tested.

Color and cleanliness of walls, ceiling, upholstery and floor.

Type of lighting fixtures and record of which ones are lighted.

Cleanliness of lighting fixtures.

Wattage and rated voltage of lamps.

Voltage at switchboard.

Voltage at lamp sockets.

Color of lamps, especially if fluorescent.

Locations where readings are taken.

Whether readings are taken on horizontal, vertical or 45 deg. plane and distance above floor.

Nickel-Cadmium Storage Battery

Information now available on the Nicad battery is contained in the concluding section of the report as follows:

The Nicad battery, which has been in service in Europe for a number of years, has recently been introduced in this country for use on cars and locomotives.

The battery, which is now being developed for manufacture in the United States, consists of positive and negative plates, substantially the same in mechanical construction and very similar in appearance. The active materials are contained in perforated steel pockets seamed together along the edges and locked into a steel frame. A complete plate group consists of a number of alternate positive and negative plates assembled on bolts and to terminal posts common to plates on the same polarity. The plates are insulated from one another by thin hard rubber separators. The terminal posts are steel extending through the top of the cell container or can protected by liquid-tight rubber glands. The cell container or can is made up of a welded steel and fitted with a combination vent and filler opening. The inter-tray connectors are flat strip type held by nuts on the terminal posts. All steel parts are nickel plated. At present the batteries are assembled in wooden trays.

The active material of the positive plate consists of nickel hydroxide and specially treated graphite.

The active material of the negative plate consists of a mixture of oxides of cadmium and iron.

The electrolyte is a solution of pure caustic potash (KOH) in distilled water, with a normal specific gravity of 1.190.

The advantages claimed by the manufacturer include the following: Long life, low operating cost, no plate destruction due to swelling or buckling, low internal resistance, low water consumption, may be operated at high temperatures, not damaged by low temperatures, no deterioration of plate separators, has high capacity at high discharge rates, may be discharged at practically any rate and is not damaged by rates, may be discharged at practically any rate and is not damaged by remaining in any state of charge or discharge.

At the time this report was prepared, there were no actual installations of this battery on cars. A battery suitable for 110-volt service has been completely developed and, it is expected, will shortly be tried out in service. A plate of suitable size for application in A. A. R. standard battery boxes and somewhat thicker is being considered for 32- and 64-volt batteries. The existing plates are too large for standard boxes and are thinner than necessary for service on air-conditioned cars.

Tests have been conducted by the manufacturer and witnessed by representatives of several railroads on a three-cell 90-amp. hr. capacity at the 8-hr. rate, 29-plate battery. The results of these tests were quite satisfactory but without a service test are not conclusive. The curves on these tests are not included with this report as the characteristics may change with the development of the new size and thickness of plates. The regulator settings will be the same as for lead battery applications.

The following based on tests of three cells, 90-amp. hr. capacity:

1—This battery, at higher discharge currents than 8-hr. rate, will still maintain rated capacity in ampere hours and this holds true until about the 2½ hour rate is reached.

2—The performance of this battery indicates that it will compare favorably with a larger ampere hour capacity lead acid battery, and probably with a nickel iron battery, when operated at the higher discharge rates.

3—Battery may be charged at a low voltage and high current during most of the charging period. Near end of charge, it is characteristic of the plates to have an abrupt rise in voltage. On discharge, voltage is maintained during most of the discharge period but falls off rapidly near end of complete discharge. One difficulty with these characteristics is that the voltage reading does not indicate the state of discharge.

4—The question of battery life and maintenance can only be developed by actual service test.

The report is signed by L. J. Verbarg (*Chairman*), air-conditioning engineer, Missouri Pacific; J. E. Gardner, electrical engineer, Chicago, Burlington & Quincy; E. S. M. Macnab, train-lighting engineer, Canadian Pacific; F. O. Marshall, assistant chief engineer, Pullman Company; S. B. Pennell, junior engineer, New York Central; G. W. Wall, foreman electrician, Delaware, Lackawanna & Western; J. D. Younger, electrical engineer-equipment, Illinois Central; M. A. Pinney, assistant electrical engineer, Pennsylvania; H. M. McKay, electrical engineer, Central of Georgia; C. P. Taylor, electrical engineer, Norfolk & Western; H. W. Wreford, chief train-lighting inspector, Canadian National; L. C. Bowes, electrical engineer, Chicago, Rock Island & Pacific.

Discussion

In the opinion of one questioner, the real advantage of the amplidyne inverter to car power requirements cannot be realized until it includes the compressor motor which can then be hermetically sealed in the compressor unit. Answer to this question showed that units of the required size had developed trouble due to a mixture of oil and freon which attacked the motor insulation and that manufacturers say they do not know how to build such a compressor for an eight-ton air-conditioning unit. Supplementing this, it was stated that there is no loss in efficiency with the d. c. motor as it operates on unregulated voltage. Other motors such as the evaporator blower motor, when used on a. c., received their power through the inverter, and when d. c. is used, are operated through a voltage regulator. The losses through the amplidyne are no greater than through the voltage regulator. The motors which will use a. c. with the present inverter system operate in relatively inaccessible places. Brushes are apt to cause trouble and with a. c. there are no brushes in such places. There are brushes on the amplidyne inverter, but they are accessible, and its use consists partly of exchanging inaccessibility for accessibility. The Pennsylvania will have 300 cars equipped with amplidyne inverters.

Evidence was introduced to show that d. c. blower motors are adequately dependable, and a counter-argument given to this statement was that the evaporator motor is a little better when it is an a. c. machine than when it is a d. c. machine, since its reliability is then the reliability of the amplidyne.

It was pointed out that the efficiency of a lamp regulator, when the generator is running, is about 75 per cent, and that when operated from the lamp battery, is about 92 per cent. It was further

stated that although the amplidyne might not represent a gain in efficiency, it was highly desirable to work out all the potentialities of a. c. power. Concerning its reliability it was said that the amplidyne gave remarkable reliability in many wartime applications, and that if it will do as well in railroad service, it represents an improvement.

It was suggested that the railroads should ask the manufacturers to undertake the development of a sealed compressor for an 8-ton unit. Attention was called to the fact that the Westinghouse Diesel-powered car on the Chicago, St. Paul, Milwaukee & Pacific, employed two sealed compressors, and that perhaps the two compressors could be sealed because the units are smaller.

The opinion was expressed that the railroads have reached the limit of axle power with 30-kw. generators. This led to the discussion of engine operation and the question was raised as to how the committee arrived at its recommendation for 6,000 to 7,000 hrs. operation between overhaul periods for Diesel engines. This, it developed, was a manufacturers' recommendation based on their experience, which was also chosen, since this is about the time the engine would have to run between annual overhauls. It was felt that this would answer operating requirements and could probably be increased, and it was further stated that most trouble is caused by auxiliaries rather than by the main engine. The Westinghouse unit, it was explained, was installed on a reconditioned car (No. 4049), that it has run about 10,000 miles including tests at high altitudes, that refrigeration is developed by two 5-hp. compressors, that it is still in perfect condition, and that compressor starting does not show on the fluorescent lights. The unit provides heat as well as cooling, and makes the car completely independent. In response to a question about the possibilities of under-car mounting, it was said that the present units are above the car floor, but that others for under-car mounting are being developed. A steam heat coil, it was explained, is used for heating the car in the yards, with another in the overhead unit for emergency in case of power plant failure.

A question was raised concerning increase of costs with any type of power supply. The answer to this was that it is not a matter of first concern,—that the primary problem is getting the proper amount of power.

The accuracy of small photo-electric cells for measuring illumination was questioned, since when the hight strikes these cells from a low angle the rim around the unit may shield the light sufficiently to require a 10 to 15 per cent correction. The committee chairman replied that such a correction is necessary with the ordinary small photo-cell, but added that more accurate measurements can be made with larger instruments and that cells with color correction do a good job of measuring all kinds of light. With some instruments, their own correction factors should be used.

The reports of the Electrical Section, Mechanical Division Committees on Car Air Conditioning Equipment and Application of Radio and Communication Systems to Rolling Stock will be covered in the December issue of *Railway Mechanical Engineer.*

R. E. S. M. A. Elects Officers

At its Annual Meeting held in Chicago, October 24, 1946, the Railway Electric Supply Manufacturers Association elected the following slate of officers: President: A. L. McNeill, The Okonite Co., Chicago; Senior Vice President: L. A. Spangler, Westinghouse Electric Corporation, Chicago; Junior Vice President: G. B. Miller, Loeffelholz Company, Milwaukee, Wis.; Secretary-Treasurer: John McC. Price, Allen-Bradley Company, Chicago.

Directors: B. G. Durham, Albert & J. M. Anderson Mfg. Co., Chicago; W. R. Knappenberger, Electric Storage Battery Co., Chicago; C. G. Callow, Waukesha Motor Company, Waukesha, Wis.; E. K. Lofton, Dayton Rubber Mfg. Company, Chicago; A. E. Swedenborg, Benjamin Electric Mfg. Co., Des Plaines, Ill.; W. E. Lynch, General Electric Company, Erie, Pa.; F. J. Burd, Cutler-Hammer, Inc., Chicago; L. H. Gillick, Vapor Car Heating Co., Inc., Chicago; W. L. Johnson, Crouse-Hinds Co., Syracuse, N. Y.

Recessed Back-Up Light

To avoid damage to its locomotive back-up lights, the Norfolk & Western has recessed them into the water space at the back of the tenders at a point near the top, and at one side ofth e tank. This arrangement has been applied to its Class A, E2, J, K1, K2, Y4, Y5 and Y6 locomotives. Damage to lights has been practically eliminated by this method of mounting. The greatest hazard was the water crane when the back-up light was located on top of the tank.

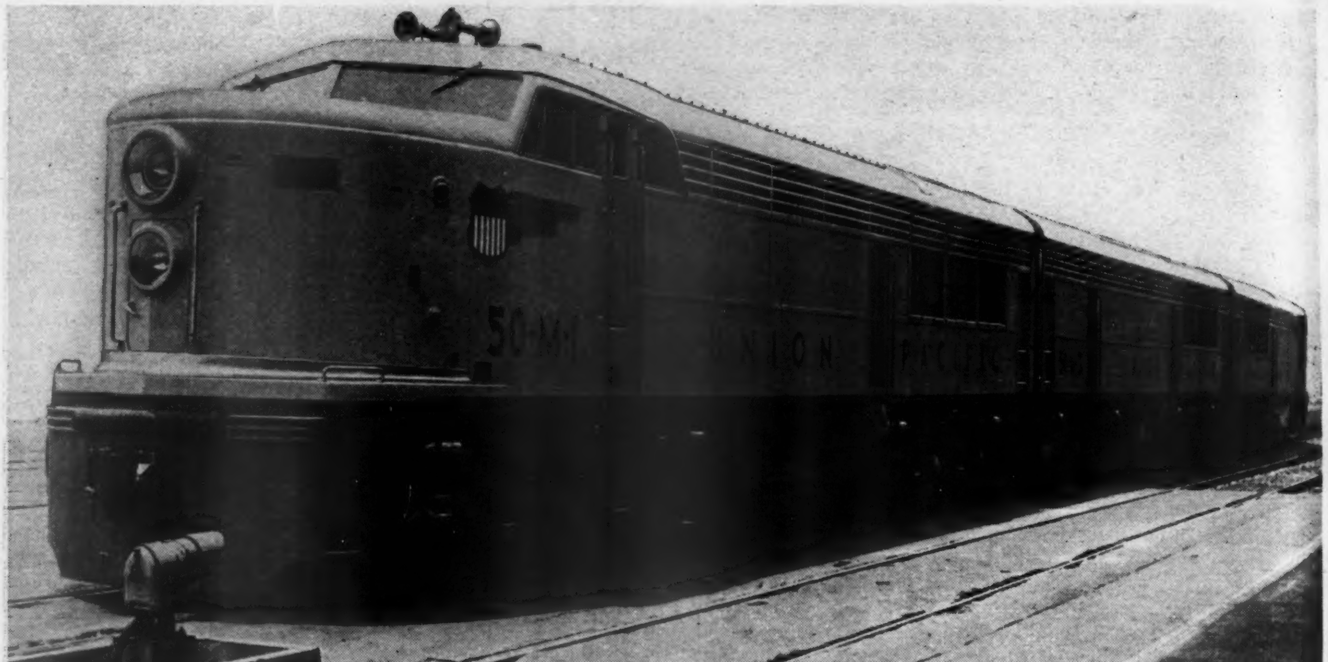
To accomplish this, an 18-in. circular opening is cut in the end of the tank, 14½ in. below the top plates of the tank, and 2 ft. 8 in. from the centerline of the tank. Around this opening on a $9\frac{15}{16}$-in. radius are eight, evenly-spaced, tapped holes for the cap screws which hold the Pyle-National C-37880 headlight in place.

Since the headlight projects into the water space, it must be protecte d from the water. This is accomplished by welding a cylindrical metal housing, which covers the hole, to the inside of the tank. This housing, which is of welded construction, is made of ¼-in. steel plate and is 22 in. in diameter and $9\frac{11}{16}$ in. deep.

Conduit connection is made by a piece of extra heavy ¾-in. pipe which is welded into a hole in one side of the

Back-up lights which are recessed into the water space are isolated from the water by a welded housing

housing and brought up in the form of a sweep ell through the top deck of the tank to a Pyle-National STB-22, ¾-in. conduit fitting. From this fitting, the wires are carried in ¾-in. metal conduit welded at intervals to the inside coping of the tender and terminated at the front end of the tender where the No. 14, two-conductor Tirex cable is secured by a strain relief bushing and carried across the space between tender and locomotive. The cable is terminated with a Mines Equipment type SR plug which fits a corresponding receptacle mounted on the under side of the cab roof.



First Fairbanks-Morse

Road Diesel Locomotive

The Union Pacific has purchased the 6,000-hp. 3-unit locomotive after an extensive period of tests in freight and passenger service

THE Union Pacific has purchased the first Fairbanks-Morse 6,000-hp. Diesel-electric road locomotive following a period of service tests principally through the western mountain and desert territories of this railroad. For the earlier tests, the locomotive was geared as a combination freight and passenger locomotive to obtain a maximum speed of 75 miles an hour. For the later tests the locomotive was operated in fast passenger service with a gear ratio designed for speeds up to 102 miles an hour suitable for post-war passenger and streamlined schedules.

This locomotive, which was assigned to handle streamliner and other fast passenger trains on long through runs, consists of three 2,000-hp. units coupled together for multiple-unit operation with an engineman's cab at each end of the locomotive. The general dimensions of the locomotive, weights and tractive effort, are given in one of the tables. Each of the three locomotive units is mounted on two six-wheel trucks, with motive power derived from a complete 2,000-hp. Diesel-electric power plant which supplies 600-volt electrical energy to traction motors geared to the two outside axles of each truck.

Underframe and Body

The underframe and body are of all-welded steel construction. The car body structure comprises a welded-steel frame with metal-covered side closures applied in such a way as to prevent warping and weaving and so retain the smooth streamline appearance of the exterior regardless of stresses set up in the side frame.

The underframe is built up of steel plates and shapes which have first been accurately cut to size with a power shear or flame-cutting equipment from a template or layout. All are welded into unit integral construction. The two center sills run the full length of the platform under the deck plate. The cab sides, of truss construction, are welded to the cross members and side sills. The frames are built to the requirements of A. A. R. specifications for new passenger-car equipment where these apply. Floor plates of steel are welded to the underframe with non-skid passage ways through the engine-room. The draft-gears pockets are also of welded steel construction, built integral with the underframe. The draft gear is of the National rubber-cushion type while the couplers are tight-lock, automatic swivel-butt type.

Welded Locomotive Trucks

The two six-wheel pedestal trucks on each unit were built by the General Electric Company. The structural parts are fabricated into an integral unit by the welding of accurately cut shapes and plates. The truck parts consist essentially of two side frames, a cross tie at each end, two pedestal units and a swing bolster. The side frames have journal box openings and spring suspension.

The swing bolster is an integral fabricated structure carried by four semi-elliptic springs at each of four corners. It is designed for 2¼-in. free lateral motion. The lateral shock on the trucks is cushioned by maens of a spring-loaded arrangement in the truck pedestal jaws. The complete truck is designed to provide increased strength with decreased weight at reduced cost.

The rolled steel are 40 in. in diameter with rims 2½

Fairbanks-Morse 6000-Hp. Three-Unit Diesel-Electric Road Locomotive

Horsepower:	
Gross	6,300
Net to traction generators	6,000
Weight:	
Total with all supplies fully loaded	1,005,600 lb.
On driving axles (12)	696,900 lb.
On idle axles (6)	308,700 lb.
Width overall	10 ft. 6 in.
Height overall	15 ft. 1 in.
Length:	
Three units, inside knuckles	194 ft. 6 in.
Between truck centers, each unit	36 ft. 5 in.
Truck wheel base	15 ft. 5 in.
Min. radius of curvature (loco. only)	275 ft. or 21 deg.
Wheel diameter	40 in.
Gear ratio	63/24
Maximum permissible speed	102 m.p.h.
Speed at continuous rating	23 m.p.h.
Tractive force:	
Continuous	83,000 lb.
At 25 per cent adhesion	165,000 lb.
Maximum at start	165,400 lb.
Braking effort, maximum	78,600 lb.
Speed at maximum braking effort	26 m.p.h.
Journal bearings, anti-friction	$6\frac{1}{2}$ in. by 12 in.
Supplies:	
Fuel oil	1,600 gal./cab
Lubricating oil	240 gal./cab
Engine cooling water	490 gal./cab
Sand, total locomotive	114 cu. ft.
Engine:	
Type	F-M, No. 38D, 2-cycle
Cylinders	10 opposed pistons
Bore and stroke	$8\frac{1}{8}$ in. by 10 in. by 10 in.
Rated speed	850 r.p.m.
Idling speed	300 r.p.m.
Motors, number and type	12—GE-746
Trucks:	
Type	Swinging bolster
Material	Welded steel
Steam generators, number and capacity	3—2,250 lb. per hr.
Power plant regulating system	G.E. electro-hydraulic
Auxiliaries	Electrically-driven
Radiator shutter control	F-M automatic modulating

in. thick, heat treated, and turned to A.A.R. standard contour. Clasp brakes on each wheel are actuated by a separate air cylinder. Wheel and axle assemblies are removable with the motor.

Power Plant

Each of the three power plants consists of a 2,000-hp. Diesel engine, direct-connected to an electric generator, four traction motors on trucks, wiring and controls.

The engines are of Fairbanks-Morse manufacture, 10-cylinder two-stroke cycle opposed-piston type. The feature of this design is the use of an open-end cylinder in which combustion takes place in the middle between two pistons which move away from each other and in so doing uncover the exhaust and air inlet ports, thus eliminating all valves and cylinder heads. The two crankshafts are mechanically connected by means of a vertical shaft and bevel gears which transmit power from the upper to the lower shaft and maintain the proper timing between the upper and lower pistons. Thus with a pair of pistons in each cylinder, the 10-cylinder engine in reality becomes a 20-cylinder engine.

The opposed piston engine is compact and simple in design and the piston speed is lower for a given effective stroke. The cylinders are in-line, with $8\frac{1}{8}$-in. bore and have a combined stroke of 20 in. The main frame or cylinder block is of welded steel construction. The engine is a complete self-contained unit with rotary type blower (driven by the upper crankshaft) and fuel, lubricating-oil and water pumps (driven by the lower crankshaft). The air supply from the blower for scavening and supercharging the engine passes into the cylinders through ports in the cylinder walls uncovered by the upper pistons while exhaust gases pass out in a like manner through ports uncovered by the lower pistons. Fuel is supplied by direct injection into the cylinder combustion space by two injection pumps and two nozzles for each cylinder.

As each unit of the locomotive contains only one complete power plant there is ample aisle space and head room around the engines, thus making it possible to perform ordinary maintenance readily and to do major overhauling without removing the Diesel engine from the cab.

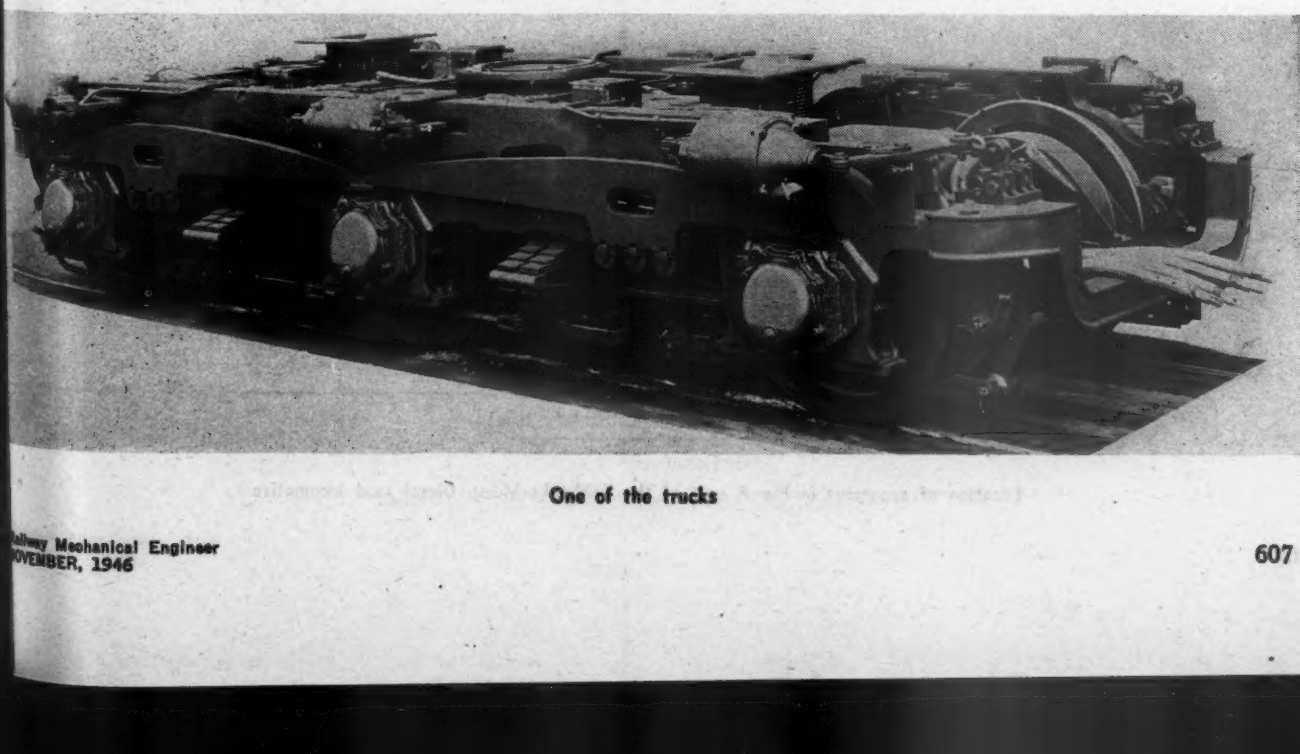
Main Generator and Traction Motors

The main generators are shunt-wound commutating-pole-type, of General Electric manufacture, supplying electrical energy at constant horsepower to the traction motors. The main frame is of rolled steel welded construction and the frame head of welded steel construction.

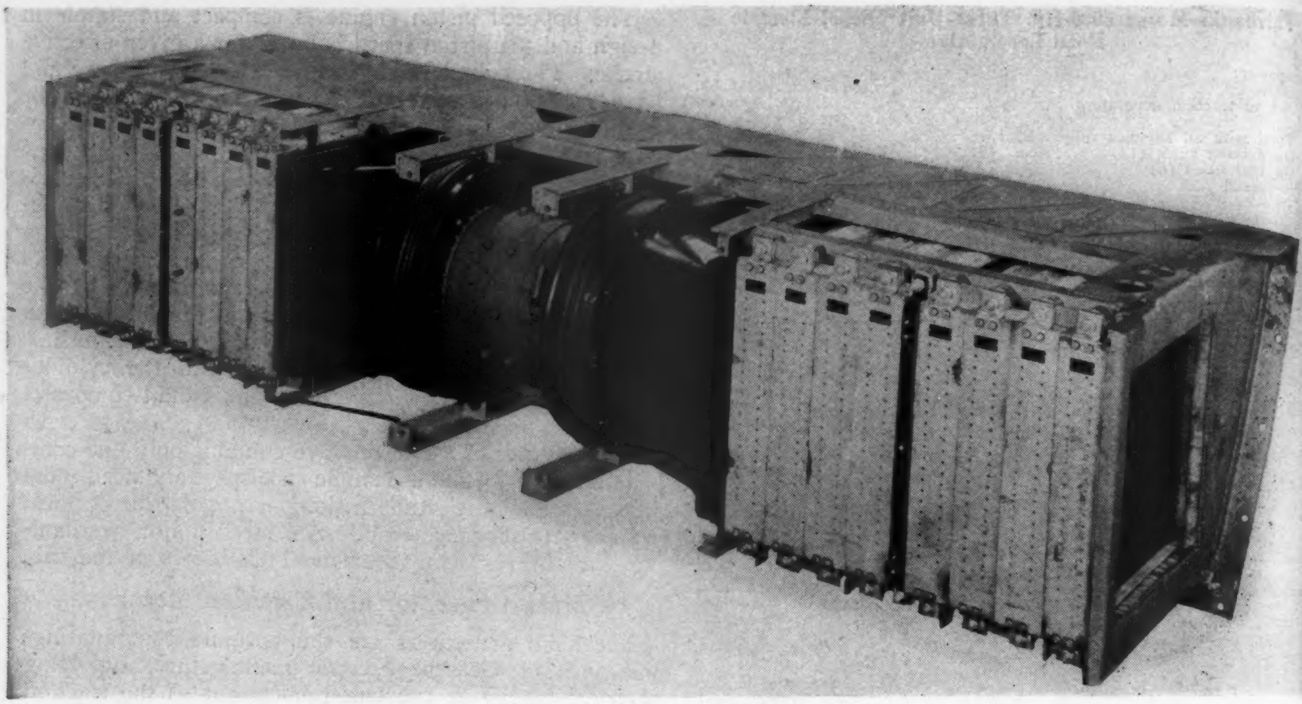
The main generator is self-ventilated by a fan located at the coupling end while a scroll is provided to discharge the heated air outside of the cab. A damper placed in the discharge duct permits, at the option of the operator, recirculation of generator air in cold weather to assist in keeping the engineroom warm.

Three auxiliary generators, all of G. E. make, perform the following functions: one, the amplidyne exciter (AM-807) provides controlled excitation to the main generator. A 12-kw. auxiliary generator (GY-24-A) supplies power for battery charging, control and lights, maintaining a voltage of 76 volts from idle to full engine speed. The third machine of 51-kw. (GY-24-B) furnishes power for two radiator-fan motors and two traction-blower motors.

The G. E. traction motors (GE-746) are direct-current, series-wound, commutating-pole type. Each is force-ventilated by means of a vertical, direct-connected, motor-driven, axial-flow fan. Advantages claimed over the conventional type of centrifugal blower are a saving of weight and space and better efficiency. Each of the four traction motors is single-geared to its respective driving axle. They are mounted on the axles by two sleeve-type suspension bearings and on the truck frame through spring nose supports.



One of the trucks



G-E blower-cooled dynamic-brake resistor

Power-Plant Control

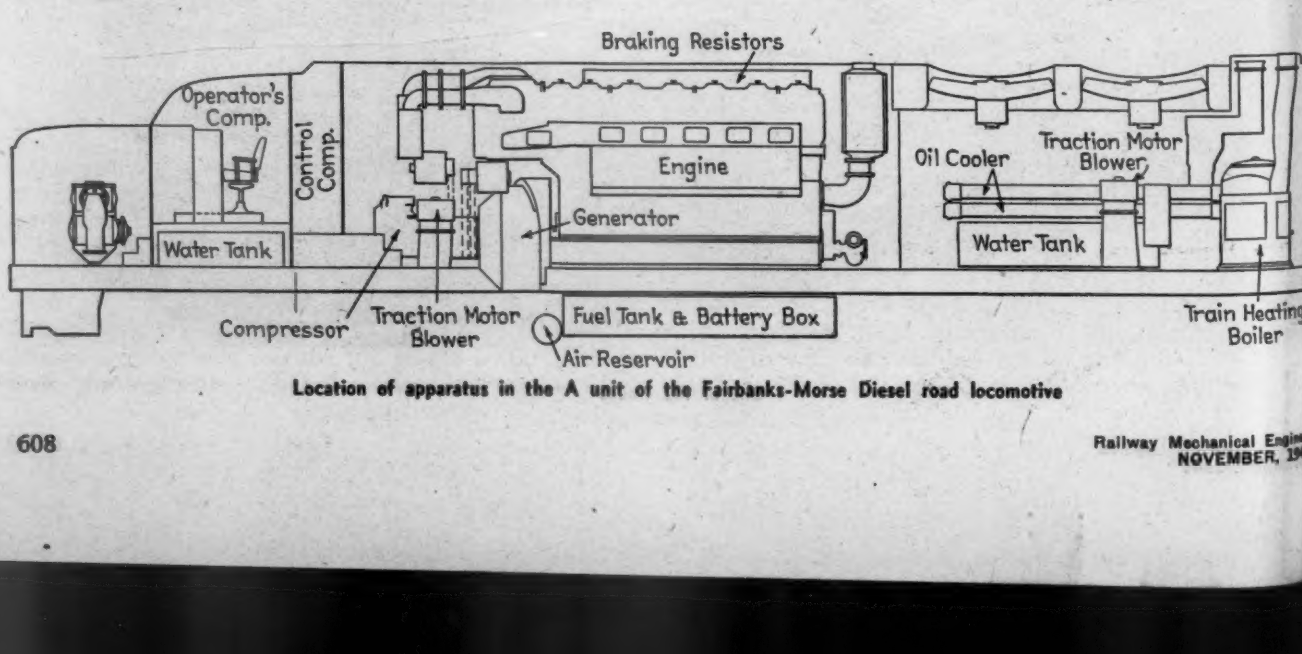
The power-plant control includes a General Electric amplidyne exciter and electro-hydraulic power-plant speed regulator. The amplidyne control maintains constant engine speed and prevents over-loading of the engine. If for any reason the power output of the engine should be decreased, the amplidyne control automatically unloads the generator so that the generator demand is proportionately reduced. This is done first through controlling the engine speed by means of regulating the amount of fuel to the engine and second, should this maximum fuel input be insufficient to produce the desired speed, the control then reduces the load on the generator.

This amplidyne is compact and resigned to govern the generator quickly by means of an extremely small electrical field input.

Cooling System

The cooling system for each engine comprises radiators located on each side of the cab to take advantage of side winds, with motor-driven radiator fans and shutters for controlling the temperature of the cooling water. There are six air-cooled radiators of the continuous-fin, flat-tube, sectional type so designed as to permit the separate removal of each 6-in. section for cleaning or replacement. Four of these cool the engine circulating water and two are used to cool the water from the heat exchanger. Control is fully automatic to maintain the engine at a constant predetermined temperature during all the time it is in operation.

Radiators are ventilated by two fans 6 ft. in diameter with two built-up blades, each driven by a vertical motor. The vertical louvres are operated by three hydraulic



Location of apparatus in the A unit of the Fairbanks-Morse Diesel road locomotive

operators, built by Fairbanks-Morse, using the engine lubricating oil under pressure. Two are controlled by the engine-jacket-water temperature and the third by the engine-lubricating-oil temperature.

The louvre operators are fitted with temperature controls to close the louvres at low temperature and to open them gradually as the temperature rises above a predetermined level. In conjunction with the automatic louvre control, the radiator fans are automatically controlled within the speed range, or can be shut down entirely.

The water circulating systems for jacket water and lubricating oil are separate except for filling and draining. The two-unit oil cooler is a shell and tube liquid heat exchanger. Water is circulated through the oil cooler by one of the engine pumps, and then cooled by two separate air-cooled radiators.

The air brakes are of the New York 24-R1 high-speed passenger type with electro-pneumatic application and release and with electric speed governors which control the air pressure in the brake cylinders in ratio to requirements based on traveling speed. This brake conforms to that used on streamline trains and affords a maximum speed of brake application and the train retardation with minimum risk of sliding the wheels of the train.

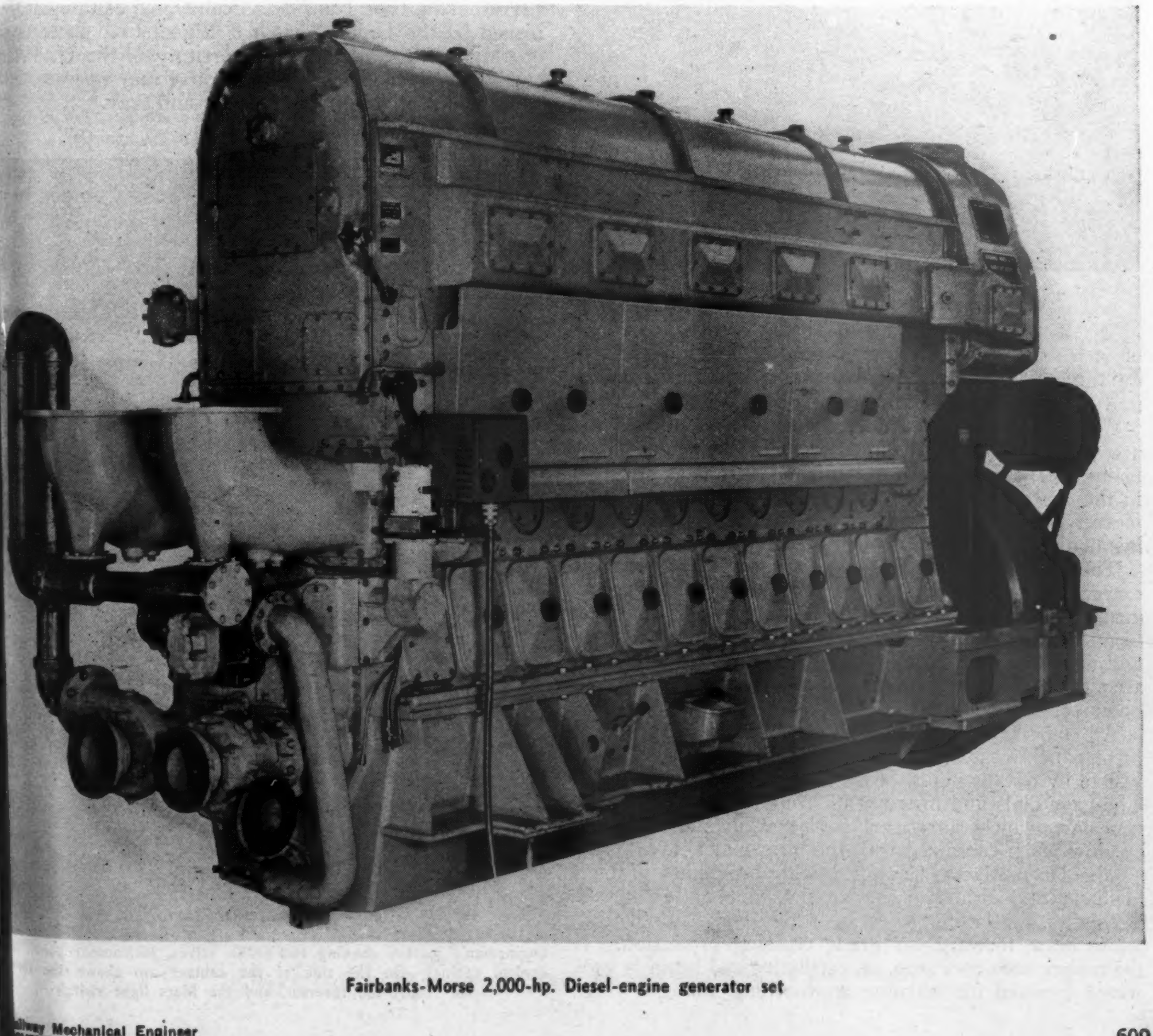
Electro-dynamic brakes are provided by which traction motors acting as generators on down grades absorb the energy of the train movement and retard the train without the use of the air brakes. This saves wheel and brake-shoe wear, eliminates thermal cracks in wheels and results in smoother handling of trains. It further minimizes slack action and reduces break-in-twos.

In passenger-train handling, the dynamic brakes are used for limiting the speed on descending grades and are supplemented by small applications of air. The electrical energy produced by the traction motors is dissipated in special resistor grids provided in the roof of the locomotive. The two banks of grids are cooled by axial flow fans mounted on each end of a motor placed between them with fans blowing outward from the center.

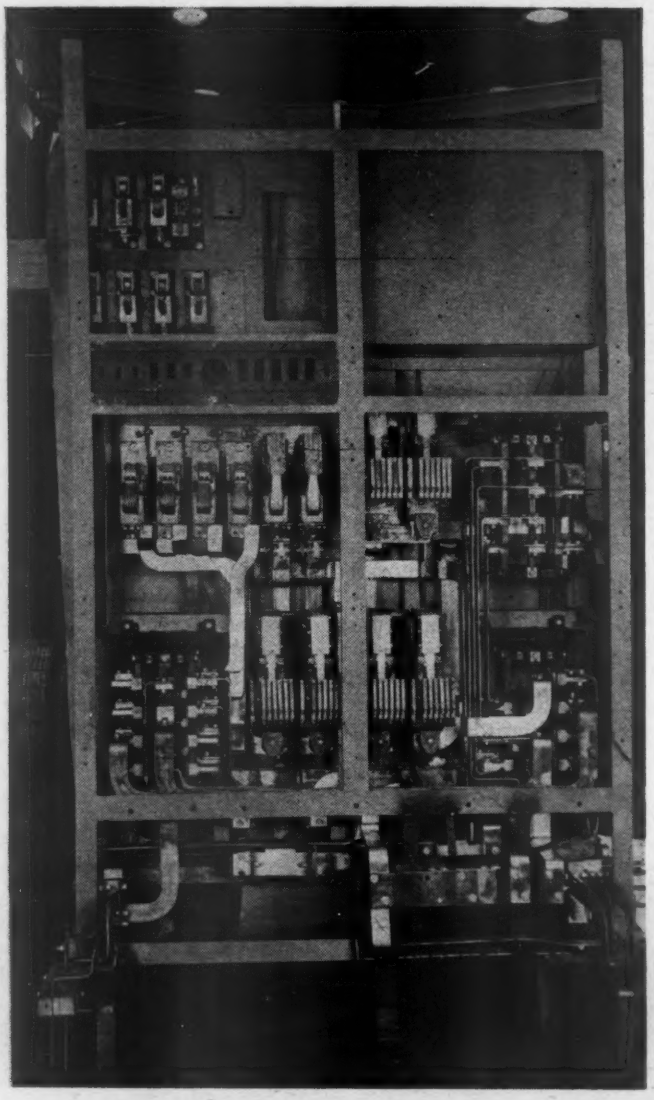
The independent brake valve is of the self-lapping type and permits gradual increase or decrease of braking pressure on all connected units. It also gives independent control of brakes during an automatic application.

The automatic brake valve is a pedestal rotary type valve incorporating all of the features that have been found to be desirable in previous automatic brakes but with provision for obtaining them with greater ease and less skill on the part of the engineman. Provision for sanding is also incorporated in the automatic brake valve through depression of the brake valve handle to depress the sanding bail and operate the sander valve. A National hand brake, wheel-type, in the nose of the locomotive applies the brakes to two axles on the front truck.

Each locomotive unit has a Vapor Clarkson coil-type steam generator for train heating. The steam capacity



Fairbanks-Morse 2,000-hp. Diesel-engine generator set



Busbar construction in a control compartment

of each boiler is 2,250 lb. of steam per hour or 6,750 lb. for the entire locomotive. The water tanks may be removed from the side for inspection or repair.

Control cabinets are made as complete assemblies and are then installed in a compartment located immediately behind the operator's compartment. Bus bars are used in the control cabinet in place of cables which results in more room for accessibility, adds to the neatness of the installation and makes possible greater cleanliness.

The roomy enginemen's cabs are set back from the extreme ends and elevated for protection of the enginemen, also for unrestricted vision forward and to the sides. Comfortable swivel-type upholstered seats with back rest and arm rests are installed for the engine crew. There are also two hot-water heaters, one located in front of each operator.

All controls are located within easy reach. An instrument panel, located at the engineman's station, is clearly visible by day or night, being illuminated by black light. The gage dials and instruments are treated with fluorescent paint which causes numerals, markings and pointers to glow when energized with the ultra-violet rays.

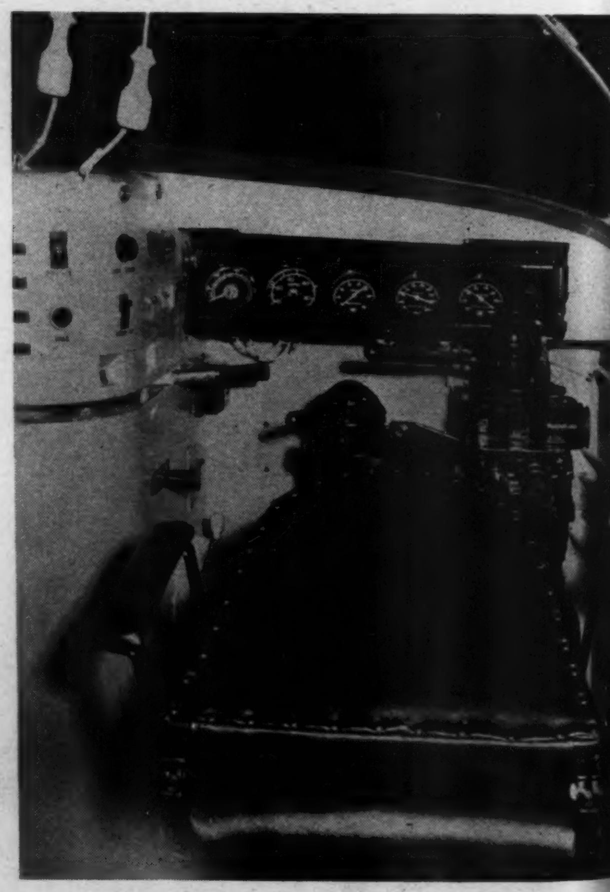
The locomotive is equipped with headlights of high brilliancy and with Mars combination white and red warning lights, the latter projecting a figure-eight oscillating white beam forward for grade crossing protection. If the train comes to a stop, an oscillating red beam is projected forward for warning approaching trains.

Partial List of Material and Equipment on the Fairbanks-Morse Locomotive

Batteries	Electric Storage Battery Company, New York
Roller bearings	Timken Roller Bearing Company, Canton, Ohio
Bell ringer	Superior Railway Products Corp., Pittsburgh, Pa.
Blowers, traction motor	General Electric Company, Erie, Pa.
Hand brake	National Brake Company, Buffalo, N. Y.
Air brakes	New York Air Brake Company, New York
Air compressors	Westinghouse Air Brake Company, Wilmerding, Pa.
Cooler, lubricating oil	Ross Heater & Mfg. Company, Buffalo, N. Y.
Couplers, titelock	National Malleable & Steel Castings Co., Cleveland, Ohio
Coupling, flexible	The Falk Corp., Milwaukee, Wis.
Diesel engine	Fairbanks-Morse Company, Beloit, Wis.
Draft gear	National Malleable & Steel Castings Co., Cleveland, Ohio
Electrical equipment	General Electric Company, Erie, Pa.
Fans	General Electric Company, Erie, Pa.
Filter, fuel oil	Purolator Products, Inc., Newark, N. J.
Lubricating oil	Michiana Products Corp., Michigan City, Ind.
Fuel filter	Protecto Seal Company, Chicago
Gauges, pressure	U. S. Gauge Company, Sellersville, Pa.
Float type fuel	Rochester Mfg. Company, Rochester, N. Y.
Reflex type fuel	Nathan Mfg. Company, New York
Headlight	Pyle National Company, Chicago
Horns, air	The Leslie Company, Lyndhurst, N. J.
Heaters, cab	Kysor Heater Company, Cadillac, Mich.
Motor, radiator blower	General Electric Company, Erie, Pa.
Muffler exhaust	Burgess-Manning Company, Chicago
Power plant regulator	General Electric Company, Erie, Pa.
Radiators	Yates American Machine Company, Beloit, Wis.
Brakes, clasp	Westinghouse Air Brake Company, American Brake Division, Swissvale, Pa.
Sanders	Graham-White Sander Company, Roanoke, Va.
Seats, cab	Coach & Car Equipment Co., Chicago
Shutters	General Electric Company, Erie, Pa.
Radiator shutter control	Fairbanks-Morse Company, Beloit, Wis.
Signal Light	Mars Signal Light Company, Chicago
Speedometer	General Electric Company, Erie, Pa.
Steam Generator	Vapor Car Heating Company, Inc., Chicago
Trucks, fabricated steel	General Electric Company, Erie, Pa.
Train control and cab signal equipment	Union Switch & Signal Co., Swissvale, Pa.

Automatic train control and cab signal equipment, furnished by the Union Switch & Signal Co., protects the operation in the train-control territory of the U. P. and other lines over which the locomotive may operate.

The locomotive is painted yellow and gray.



Engineman's station showing the brake valves, instrument panel, control cabinet—On the side of the cabinet are shown the throttle (top), the reverser, and the Mars light switch

What About

Old Passenger Train Cars?*

Composite opinion of engineers, designers, and maintenance men as to when and how to rebuild

At present, one of the outstanding problems confronting the railroads in their efforts to meet competition through modernization is the question of retirement of obsolete passenger car equipment, use which can be made of the cars relieved and the conversion of older cars not quite ready for retirement into semi-modern types with improved interior decorative treatment and equipment.

The question of retirement cannot be governed by any hard and fast rule or age limit which will automatically place passenger cars on a retirement program, as a number of things have to be taken into consideration before cars can be relieved from service. One of these is the financial picture. In other words, when business conditions are good, railroads are in a position to relieve older equipment more readily than during more trying times. In the less fortunate periods, therefore, we find cars in service which have considerable age and should be retired, but must be kept in service.

Another outstanding feature covering retirement is that of a conversion period such as we have at present when public demands require the replacement of older equipment with new and improved modern types. One of the outstanding examples of this was the creation of the streamliner type of train which was brought fourth after the last war and in many cases eliminated conventional equipment which still had many years of service left.

Taking the above mentioned facts into consideration, as well as the cost involved in maintaining older types of cars in service, the life of a car for through-line and major suburban service could be set at approximately 30 years, subject in many instances to the conditions set forth in the above paragraphs. After the period mentioned, the time has come when consideration should be given as to relieving these cars from service and demoting them to service elsewhere.

Toward making a decision as to the use of a car of this nature, the type of equipment, its condition and arrangement must play an important part, as some cars will not be adapted for other use without involving a large cost in changing over, in which case complete destruction is the cheaper method. In a large number of cases, however, cars can be placed in branch line service or converted to wreck-train, maintenance or other types of work equipment, making possible the elimination of older equipment which has completely outlived its usefulness. First consideration, however, should be given to using cars on branch or short lines, as most roads have a large number of these outlying runs on which older equipment is generally in use. It would be a good policy to use the better cars for that service and relieve older cars if possible.

During a period of conversion, the trend of style and design changes so completely that retirement is sometimes a more economical method of meeting the issue than installing newer appointments and improvements. The other angle is remodeling and converting older cars to such a degree that they will include the modern features plus improvements such as the latest decorative and color schemes, floor designs, etc.

* Abstract of a committee report presented at the annual meeting of the Car Department Officers' Association held at Chicago, Sept. 4 to 6, 1946.

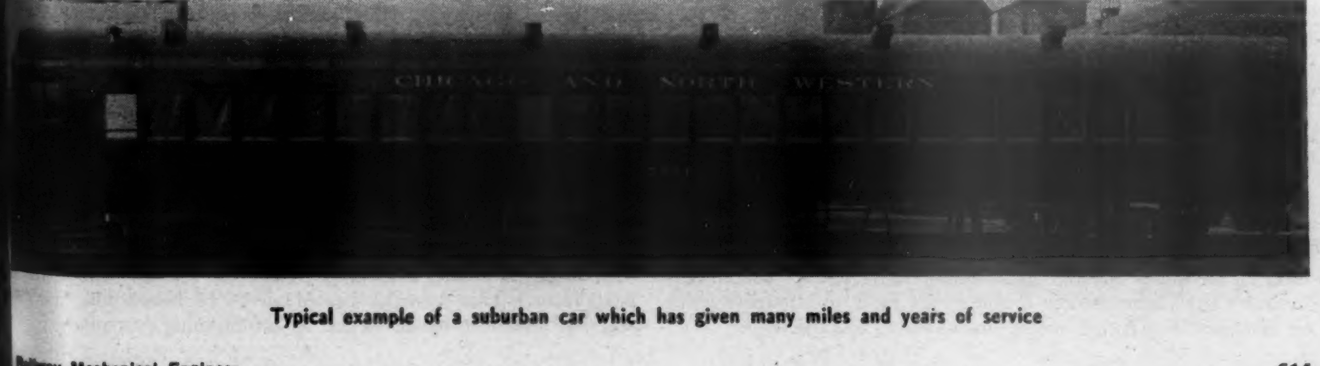
Changes in Rebuilt Cars

When it has been determined that certain older conventional steel passenger cars are to be kept in service for use in the same trains with modern streamline equipment, consideration must be given to certain body changes affecting the external general appearance. The monitar roofs and curved hoods on the conventional cars are outstanding offenders against modern streamline appearance and such roofs become objectionable when mixed with new cars in a train. If new air-conditioning is to be installed, new center ceilings to accommodate the air ducts are required in any case. The old roofs are usually in bad condition from rust and corrosion, so that with comparatively little extra expense, new roofs of A. A. R. contour 13 ft. 6 in. from rail to top of carline can be applied extending straight to the ends of car. Existing dies for the new carlines can be utilized by applying eaves mould at the side plate to make the width over the eaves the same as on the new cars. The arch roof will also result in lower future maintenance costs.

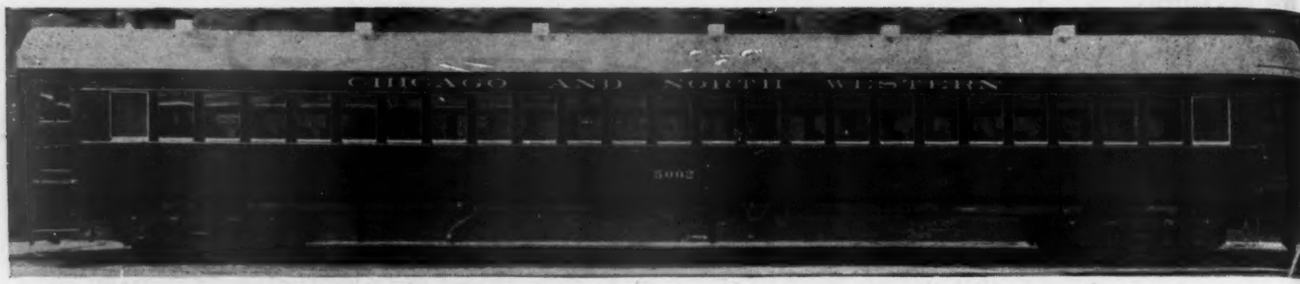
In some of the modernized cars existing windows have been removed and replaced with double-length windows. This involves major structural changes in the side frames and it is questionable whether there is sufficient gain in appearance to justify the expense. Double-glazed dehydrated or breather-type aluminum sash can be applied in the existing openings, providing satisfactory exterior appearance. If new seats are to be installed, these may be spaced at the preferred center-to-center location without maintaining any fixed relation to the windows and this does not present any serious difficulty from the standpoint of passenger vision. When changes are to be made in the toilet room arrangement or in other interior appointments involving relocation of partitions, a few of the windows may necessarily have to be relocated. Side skirts may be added or not, as desired. This feature will usually be desired if other cars are so equipped and of course all should be of uniform depth and contour. If skirts are added, folding vestibule steps may be indicated. However, the stationary steps detract very little from the appearance in the train and it is felt these can well be maintained.

Truck Changes

In the remodeling or modernizing of older passenger cars which have not reached the retirement requirements, considera-



Typical example of a suburban car which has given many miles and years of service



Exterior of the old suburban car after it has been reconditioned and modernized

tion should be given to certain features in truck design when old trucks are re-used to meet present day operating conditions with safety. When the present trucks are used in remodeling, serious thought should be given to the application of roller bearings. Proponents of roller bearings stress two advantages which they display over standard bearings, namely, decreased train resistance and decreased maintenace costs; to this could be added the elimination of a number of hot-box delays experienced with friction bearings.

When the present trucks cannot be modernized economically and new trucks are to be used, certain features affecting the riding qualities of the modern truck should be considered, such as longer swing hangers, making use of springs of high static deflection with vertical snubbing shock absorbers or a combination of coil and elliptical springs. The new truck should be equipped with brake cylinder and clasp brakes, allowing additional room under the car for application of air-conditioning equipment, etc.

On all passenger-carrying cars, the tendency is to apply a material which acts in the absorption of impact shocks or for the isolation of vibration and has a noise-deadening effect. This material can be applied under chafing plates on coupler carrier irons, on the end sill above the coupler shanks, coil spring seats, equalizer seats, journal boxes, under truck center plates, and other parts where metal contacts metal and where there is a tendency to create noise and vibration. A number of cars of the older type are now equipped with single truck brake

Interior of old-type passenger coach

and LN air brakes; consideration should be given to the application of both clasp brakes and UC air brake equipment as this later design provides a more efficient and effective brake.

To prevent corrosion and reduce maintenance of truck parts, arrangements should be made to deflect the drains from washstands, sinks, showers and hoppers from truck parts.

The material used in manufacturing vestibule diaphragm face plates can be pressed channel type instead of the solid forged rectangular bar which will be much lighter in weight and make easier the application and removal from the car. It will also reduce wear on the lower side and upper buffer center stems. Diaphragm snubbers have been used in a number of cases to eliminate noise on platform of cars, one of the main sources of criticism.

Air-Conditioning—Heating—Lighting

Many of the conventional passenger-carrying cars on railroads today are air conditioned. The air-conditioning system on a number of these cars is either run down or obsolete. The trend of late years has been to put self-powered units on the cars to take care of refrigeration and battery charging. The advantages of self-powered units are obvious but really do no better job of air conditioning than steam jets, electric-powered units or ice-conditioning systems.

Considerable rearrangement of existing parts under cars that have not been air conditioned is, of course, necessary when applying air-conditioning equipment for the first time. This detail, however, is more or less easily worked out because of the underframe construction of the conventional car. It has ample strength, depth, and room between the outside of the center-sill girder and the outside edge of the car. More difficulties are encountered with re-air conditioning equipment. Relocation of battery boxes and in some cases water tanks and air brake equipment is necessary besides removal of existing equipment, and patching of the resultant mutilation.

To provide good air distribution, the trend in later years has been away from grilles in a duct going down the center of the ceiling of the car or coming down in the wide wall between the windows and discharging the air from a grille. The use of perforated ceiling panels and specially designed ceiling air dischargers has been on the increase. These have been designed on a scientific basis and are available at the present time. The manufacturers of these products, when provided with the prints of a floor plan of the car, have done the engineering, made the recommendations and when the equipment is installed, have balanced it by means of valves provided with the equipment. Their use has been quite satisfactory in all but very special cases. When such devices are installed in a car, it is necessary in order not to present an unsightly interior appearance to redesign tthe ceiling with symmetrical lines incorporating the lighting with the new distribution device. All of this is presented to the public in a beautiful interior appearance. The old monitor or clere-story ceiling is covered up and, from the interior, the car can not be told from a modern, streamlined, arch-roof car.

One of the most comforting improvements on passenger cars within the last decade and a half has been the cooling. Any reasonable expense on a car that is of sound construction for such imporvement seems justified.

The heating of cars, built years ago, has been the old conventional type running along each side just above the floor line. Over the years, these pipes have been painted and repainted again and again until their radiating capacity is doubtful. In modernizing a conventional car to improve the heating to cut down steam consumption, the least that can be done is to remove these pipes, renew them when corroded excessively, and remove all paint and repaint with a thin coat of dark heat-resistant paint.

A more modern idea is to replace the existing steam pipes with finned radiation, thereby cutting down the amount of pipe necessary and giving a better heat radiation over the steam pipes. This can be accomplished by either a single pipe of finned radiation or an internal pipe that feeds from the opposite end of the regulator valve and returning to that part of the pipe that has the finned radiation. This requires less steam, affords better control and gives better heating than ordinary finned radiation. The heating of a car is also aided by steam being introduced into the evaporator coils of the air conditioning evaporator. This provides heated air to be blown into the car and distributed by means of the air-conditioning system.

The lighting of cars has long since been a controversial subject. Many studies by illumination engineers have been made and the trend of late seems to be towards the use of fluorescent tubes to light passenger cars. This involves an alternator to supply alternating courrent to the fluorescent lighting system. Individual lights, passenger controlled, over the seats have in many cases been installed. Some of these are fluorescent, some of them spot incandescent. The later seems to be the more satisfactory in that it provides spot lighting for each passenger. This enables a person in the seat next to the window to have the light off and not be disturbed by the passenger next to him having his light on, reading a newspaper or magazine. With the fluorescent type light two passengers accuping adjoining seats either have the light on or off. Individual desires are not realized.

Cars not equipped with self-powered generating units, but with a generating-unit driven from the axle, should have a battery of ample size, at least 500 amp. hr., which can be kept on charge while standing in terminals or depots. With a self-powered charging unit, battery charging is automatically provided. Center lighting should be of the type that is regulated for night time and evening traveling to provide comfort for passengers wishing to sleep in coaches. Parlor-car lighting is of course more or less a matter for the interior decorator. Individual lighting, however, should be more seriously considered for passenger appeal.

Interior Arrangements

Interior rearrangements seem to offer as great a field in modernization of conventional cars as any subject heretofore discussed in this paper. The old conventional passenger car, either coach or parlor, was provided with smoking rooms for the men at one end and a women's lavatory at the other. These two rooms took up much space in the car, depriving the car of seating capacity, and did not allow enough smoking space for the number of persons desiring to smoke. Nearly all of the railroad's permit smoking in the coaches or parlor cars without having to retire to the smoking room.

Rearrangement of coaches, giving a large separate room with wash basins and vanity adjacent to the toilet room, has brought about favorable comment from passengers wherever it has been used. The seating capacity is appreciably reduced, but only because the old type bucket seats were replaced by newer-type reclining chairs requiring more room. The available floor space is practically the same.

Floor plan rearrangement in nearly all cases has been necessary because the introduction of the floor-type evaporator for the air-conditioning system to give more capacity and easier maintenance than that obtained with the overhead type evaporator. These floor plan rearrangements have been accomplished with the exception of a few cases without reducing the seating capacity of the car and in a few cases it was possible to increase the seating capacity. In order to clarify results obtainable the accompanying illustrations show what can be accomplished in remodeling both interiors and exteriors.

The trend in interior colors in most cases is toward a variety of pastel and bright combinations, which are more pleasing to the eye than the old drab effects. However, in making this change, consideration should be given to serviceable colors, in other words, those of which the patrons will not tire and which will be lasting from a maintenance standpoint.

While this statement applies mainly to the interiors, in many instances desirable and satisfactory effects have been obtained by color distribution and placing on the exteriors. Color distribution on the interiors of passenger cars is chiefly concerned with obtaining a clean cut, pleasing appearance for the traveling public. In modernization programs of conventional type cars, the cost factor is an important consideration. Therefore, it is desirable that the color schemes adopted should not be too elaborate but confined to possibly three colors. This applies particularly to coaches.

Color Schemes Important

When we speak of color, we refer to more than merely the paint. The general color scheme includes seat coverings, floor coverings, window shades, lighting effects, and, of course, the finish as applied to the ceiling and side walls. Most of the car builders and major paint manufacturers have departments which may be consulted on problems connected with interior and exterior decoration. As stated previously, it is desirable to hold the color schemes to a minimum number on any group of cars. The paint-finishing materials going on most new and old passenger train cars today are mainly rubbed effect or semi-gloss synthetic enamels on the interiors with a photo-volt glossmeter ranging from 50 deg. to 65 deg. From a practical standpoint, a degree of gloss approaching a reading of 75 deg. will assist materially in reducing maintenance and cleaning costs. We suggest that the most pleasing results may be obtained from pastel shades of the following colors, namely: blue, yellow, tan, green and various combinations of these colors. Here again we wish to stress the necessity for obtaining competent advice in the selection of color schemes.

Inasmuch as most of the finishing materials used on passenger cars today are applied with a paint spray gun, the safety factor for the protection of the operator should be considered. For this reason we suggest that lead-free materials are obtainable to a great extent in most of the finishes applied through the use of a spray gun. The more elaborate the color schemes used, particularly where the paint is involved, the greater the labor cost

Interior of reconditioned and improved suburban car

because of the masking operations and the necessity for stocking the various colors in small quantities. In adopting color schemes where any considerable number of cars are involved, it will facilitate the problem for the manufacturer of the finishing materials as well as the paint shops if the group of cars to be finished with any one color scheme is as large as possible. From the manufacturer's standpoint on both cost and ease of handling, minimum quantities should be 100 gal. or more. Where the quantities are below 100 gal., it is usually necessary to charge a premium because of the cost involved in handling small batches.

In a great many instances on the interior of conventional type cars the inside finish of wood has been veneered with high grade wood, such as mahogany and walnut, with bleeding stains applied over them. When a synthetic system is to applied over such surfaces, a check should be made to determine whether or not the stains used on such surfaces are of the bleeding type. In that event it is desirable to remove the old finish.

In any modernization program, we understand it is the intention of most railroads to amortize the cost over periods ranging from five to fifteen years. For this reason we suggest that, where cars are to be retained in service for a period not to exceed five years, the old finish be saved as far as possible and the new finish be applied over it using a schedule of operations as follows: Clean old surfaces, both exterior and interior; sand as required and remove all loose paint; spot prime and putty as required; apply sealer ground coat of desired shade; apply two coats of enamel.

Where the cars are expected to remain in service for ten years or more and a considerable amount of remodeling has been done, we believe the old finish should be entirely removed both on the interior and exterior and the surface finished in the same manner as new equipment, using the following schedule of operations:

(1) Remove old finish. (2) Prime using the proper type of

primer on each surface, whether it be steel, aluminum, galvanel metal, or wood, or composition surfaces, such as masonite or agasote. (3) The application of surfacers or fillers on these various surfaces is optional; however, it is desirable to do some surfacing, using liquid surfacers or knifing composition if a smooth finish is to be obtained. (4) After the rubbing and sanding operations, we recommend a minimum of two coats of the synthetic enamel in the desired shade be applied. However, for best results we suggest three coats of enamel. This applies to both interiors and exteriors.

We wish to stress here that the best quality of finishing materials obtainable are at all times desirable because of the labor costs involved in obtaining a satisfactory finish. Usually the labor costs range from two to three times the costs of the finish materials, particularly where many masking and surfacing operations are involved.

Floor Covering

The next step toward bringing older equipment up to a more modern effectiveness is the change in floor covering which must be judged from the same standpoint as the interior painting; that is, a covering both pleasing in appearance yet sturdy for lasting service. At present, in a great many of our conventional cars in service, little thought has been given to floor covering of any other materials than subdued shades of floor paint or similar colored covering. Now, however, we find that brighter and pleasing floor combinations are being made from asbestos and linoleum floor tile, as well as colors in rubber covering. The covering on seats and in some cases the seats themselves must undergo a change. In most cases, the older seats can be made to serve the purpose and be very presentable; the only provision necessary is the use of a more outstanding shade of plush covering, etc., to match the color scheme employed on the interior walls, ceiling and floor covering of these cars. We find that the idea seems to be the use of numerous colors to blend with the variation in painting.

The curtains in cars must also undergo a change to perfect the arrangement on interiors in passenger equipment and toward this end a change toward patterned material is taking the place of the solid colors usually found in our older equipment.

Present Passenger Car Status

Just how many heavy conventional passenger cars may be profitably modernized and rebuilt is a question which individual railroads must answer in the light of their own particular operating conditions, traffic requirements and the age and condition of the particular cars in question. A large volume of new cars must be purchased at an early date to replace obsolete equipment, which will have to be retired shortly. In addition to the new cars it will be necessary to modernize a substantial number of conventional cars in order to maintain the passenger traffic we now have.

The following tabulation has been prepared to show the number of cars in the modern lightweight, modernized conventional, and conventional groups together with an estimate of the remaining service life of these cars. The most important fact brought out in preparing this tabulation is that almost half of the cars in service today are over 27 years old. This means that these cars were built before 1919, or, since very little car construction was done during the war, most of these cars are 30 years old, dating back before World War I.

Present Status of Railway Passenger Equipment

	Head end	Coaches	Sleepers	Other types	Totals
Modern lightweight cars	1,900	2,200	1,700	700	6,500
Modernized conventional cars	7,000	5,500	3,700	800	17,000
Other conventional cars	7,300	12,700	3,100	1,100	24,200
Totals	16,200	21,300	7,600	2,600	47,700
No. useable for 5 yr., maximum	16,200	8,600	4,500	1,500	30,800
No. useable for 7 yr., maximum	8,900	8,600	4,500	1,500	23,500
No. useable for 12 yr., maximum	1,900	2,200	1,700	700	6,500

It is assumed, based upon past practices of the railroads, that the following program will be followed: Complete modernization, 2,000 cars; partial modernization, 12,000 cars; scheduled maintenance, only, 19,000 cars.

Specifications for Passenger Car Modernization Program

Complete Modernization

A

1—Application of roller bearings
2—Application of UC air brake equipment
3—Shock-absorbing material in truck construction
4—Application of clasp brakes
5—Grinding of wheel treads
6—Redesigning of springing for easier riding

B

1—Removal of monitor roof and adoption of A.A.R. contour of 13 ft. 6 in. from rail to top of carline
2—Application of double glazed dehydrated or breather type aluminum sash with no change in window size
3—No addition of side skirts
4—No change in end construction

C

1—Application of air conditioning
2—Application of perforated ceiling air distribution
3—Design ceiling to present a symmetrical appearance and eliminate any trace of the old monitor or clere-story appearance
4—Application of finned radiation and zone heating
5—Application of fluorescent center lighting, and individual seat lighting
6—Application of ample battery power—at least 500 amp. hr.
7—Elimination of old type smoking rooms
8—Installation of larger toilets for men and women, including wash and dressing rooms
9—Arrange floor plan to utilize floor type evaporators for easier maintenance
10—Apply seats of modern design, reclining type, covered with pleasing upholstery

D

1—Sand blast or otherwise remove all exterior paint
2—Remove all interior varnish or paint
3—Prime with lead—free primer
4—Paint exterior with good-quality, high-gloss paint, lead free, suitable for spraying
5—Paint interior with pastel shades at recommendation of railroad's interior decorator.
6—Good quality of paint or varnish, or synthetics to be used in all applications

Partial Modernization

A

1—No change in journal bearings
2—Reconditioning of present brake equipment
3—Building up, and refitting of present truck parts
4—Reconditioning of present brake rigging
5—Grinding of wheel treads
6—Redesigning of springing for easier riding

B

1—Repair of present roof structure to result in no leaks, squeaks or unsightly appearance
2—Sealing of all window sash, including renewal where necessary to achieve absence of rattling and non-leakage of air
3—No addition of side skirts
4—No change of end construction
5—Repair of defective side, end and roof sheets

C

1—Application of air-conditioning
2—Application of perforated ceiling air distribution, side panels, or approved air distributors
3—Application of ceiling design to eliminate appearance of old type monitor ceiling
4—Modernize lighting using incandescent rather than fluorescent
5—Remove, clean thoroughly and replace heating system in kind
6—Application of ample battery power—at least 5000 amp. hr.
7—Eliminate old type smoking rooms
8—Install larger toilets and wash rooms
9—Install floor type, rather than ceiling type evaporators
10—Refinish and re-upholster present seats with pleasing upholstering

D

1—Spot glaze all imperfections
2—Spot glaze all interior imperfections
3—Apply first coat of good quality paint
4—Apply finish coat of good quality paint.
5—Interior to be painted with good quality pastel shade according to recommendation of decorator
6—Good quality of paints, varnishes or synthetics to be used in all applications

For Cars to be Used Five Years or Less

A

1—No change in trucks to repair in kind and grind wheel treads

B

1—Repair sides, roofs and ends in kind
2—Seal all kindows, including sash and glass

C

1—Apply air conditioning
2—Lowest priced air distribution
3—No change in ceiling design other than necessary for application of air conditioning
4—Apply electric lighting—incandescent
5—Remove, clean thoroughly, and replace heating in kind
6—Apply serviceable batteries
7—No change in interior arrangement
8—Install floor type evaporators
9—Recondition seats

It will be noted that no mention has been made of generators for any cars. On air-conditioning systems employing self-

(*Continued on page 620*)

The Coal-Fired

Gas Turbine Locomotive*

By John I. Yellott† and Charles F. Kottcamp‡

Proposed design will use open-cycle turbine and an electrical transmission—Thermal efficiency expected to be about 24 per cent

It was a committee of the Railway Fuel and Traveling Engineers' Association, under the chairmanship of L. P. Michael, then chief mechanical engineer of the Chicago & North Western, which first explored in detail the possibilities of the gas turbine as a prime mover for locomotives on American railroads. The added incentive of the possibility of using bituminous coal as the fuel supplied the economic motivation for the program on which the Locomotive Development Committee is now engaged.

The successful application of the open-cycle gas turbine by the Brown-Boveri Company of Switzerland to locomotive drive turned the thoughts of engineers some ten years ago to the possibility of this prime mover. So rapid has been the development of the gas turbine that it is already in practical use for many applications, and it will apparently virtually dominate the high-speed aircraft field within the next several years.

The operation of the gas turbine has been adequately explained in many recent publications, although the possibilities of its use with solid fuel are only now being explored. In operation atmospheric air, compressed to about 75 lb. per sq. in. in a highly efficient compressor, enters a heat exchanger at a temperature of about 434 deg. F. This heat exchanger transfers to the compressed air some 50 per cent of the heat available in the turbine exhaust, raising the temperature of the air to about 666 deg. F. and lowering the temperature of the exhaust, because of the cross-flow nature of the heat transfer, to about the same figure. The air is then heated by the direct burning of the fuel in the combustor, raising its temperature to about 1,350 deg. F.

If this air were to expand through an ideal turbine, 163.5 B.t.u. of work per lb. of air could be recovered. Actually, the highest efficiency attainable in a present turbine is about 86 per cent to 88 per cent, and the actual work per pound of air would be approximately 140 B.t.u. The compressor requires some 88 B.t.u. per lb., and consequently the net power of the cycle would be about 52.4 B.t.u. per lb. of air circulated. Since the air is simply thrown away after it has passed through the turbine and the regenerator, there is no need to cool it. On this basis, the cycle efficiency, including the efficiency of the turbine and of the compressor, would reach 29 per cent. However, the combustor cannot be assumed to deliver perfect conversion of the energy of the fuel into heated air, although a combustion efficiency of about 96 to 97 per cent is expected at the present time. Also, there will inevitably be a pressure loss between the outlet of the compressor and the inlet of the turbine. In addition, the pressure loss through the regenerator will cause the turbine exhaust to be slightly higher in pressure than the air intake.

A pressure loss of 5 per cent between the compressor and the turbine will result in a reduction of about 2 points in cycle efficiency, from 29 to 27 per cent. The loss of about 3 per cent in the combustor will reduce the probable cycle efficiency to 26 per cent. If conservatism in the metallurgical design of the turbine indicates a reduction in maximum temperature to 1,300 deg. F., the best cycle efficiency is further reduced to about 24 per cent. It can be definitely stated, however, that this value can be attained with equipment which is available at the present time. Consequently, the opinion that high efficiency can only be obtained at extreme temperatures is erroneous, for 1,300 to 1,350 deg. can readily be reached with metals which are currently in use.

It is evident from this brief analysis that the open-cycle gas turbine is worthy of very careful consideration as a locomotive prime mover. The closed-cycle type, which uses a direct-fired air heater, can be dismissed at the present time, because of the large heat exchangers which are needed, and because of the fact that water must be used to cool the air after leaving the turbine, so that it can be reintroduced into the compressor.

The single turbine system, which uses one turbine to drive the compressor and also to supply the useful load, must use a transmission similar to that employed for the Diesel. If a split turbine is employed, in which one turbine drives the compressor and another supplies useful load, direct drive becomes possible, although reversing means must also be supplied.

In developing the program of the Locomotive Development Committee, it has been definitely decided to use the conventional direct-current transmission as speed control, reversing, and regenerative braking are all readily attained with this system. However, when mechanical transmission, with its lighter weight and high efficiency, can be used, it is to be expected that it will ultimately supplant the electrical type. The committee is actively investigating this possibility, following the recommendations originally made by Mr. Michael and his committee.

Turbine a Commercial Product

In establishing a program it was found that the four major turbine manufacturers in the United Sattes were all prepared to design locomotives which could meet railroad requirements of space and weight. Consequently, the first year of the committee's activities has been devoted entirely to developing a coal-handling system which can be applied directly to the locomotive. An obvious method of employing the heating value of coal in a turbine is to gasify the coal, and burn the resultant gas in a combustor. However, the process of gasification is a slow and costly one, and no equipment has yet been developed by which the complete conversion of coal to gas can be done within the space requirements of a locomotive. If a pulverized coal producer could be developed, with the additional development of fly-ash removing means

* From a paper presented before the annual meeting of the Railway Fuel and Traveling Engineers' Association at Chicago on September 6, 1946.

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so that the gas would be clean enough for immediate use, it would find a very ready application both to the gas turbine and to many industrial uses. Consequently, such a device is currently being studied.

The use of wayside coal preparation stations to pulverize coal, prior to loading it into special tanks on the locomotives, is not encouraging, because of the severe limitations it would place upon the usefulness of such a locomotive. Although this system was used by the Germans in their pulverized-coal steam locomotives, the committee preferred to concentrate its efforts on the development of a system which would allow the coal to be processed entirely on the locomotive. Therefore, it was assumed to be essential to find some system of pulverization which could meet the following requirements:

Coal of regular locomotive size and quality must be dried, crushed, and pressurized at rates up to 8,000 lbs. per hour. It must be fed at a controlled rate from the pressurized storage tank into an air line, pulverized to the finest practical size, and delivered to the combustor at approximately 60 lb. per sq. in. gage.

It is to be expected that a full-load coal rate of 1 lb. or less per rail hp.-hr. will be obtained by the coal-burning gas-turbine locomotive. Depending upon the length of run which is intended, from 20 to 40 tons of coal would have to be carried to enable a 4,000-hp. locomotive to run from 10 to 20 hours at full load without refueling. This would require 800 to 1,600 cu. ft. of bunker space. If the coal is to be carried directly upon the locomotive, it is quite necessary that passage-way be provided through the bunker, to enable the crew to move from one end of the locomotive to the other. If, in addition, it is necessary to restrict the height of the coal bunker to approximately 10 ft., and its width to about the same value, to fit locomotive space requirements, between 60 and 80 cu. ft. of bunker space can be made available per foot of length. This would require between 10 and 20 ft. of bunker space to carry the full coal requirements. Because of the necessity of carrying water for train-heating boilers on passenger locomotives, space must also be provided, in the frame or in other unused locations, for some 4,500 gal. Because of their simplicity and reliability, oil-fired train-heating boilers will probably be used on the first experimental locomotives, and approximately 500 gal. of light oil will be carried for this purpose. In later units, waste-heat boilers will undoubtedly be used for this purpose.

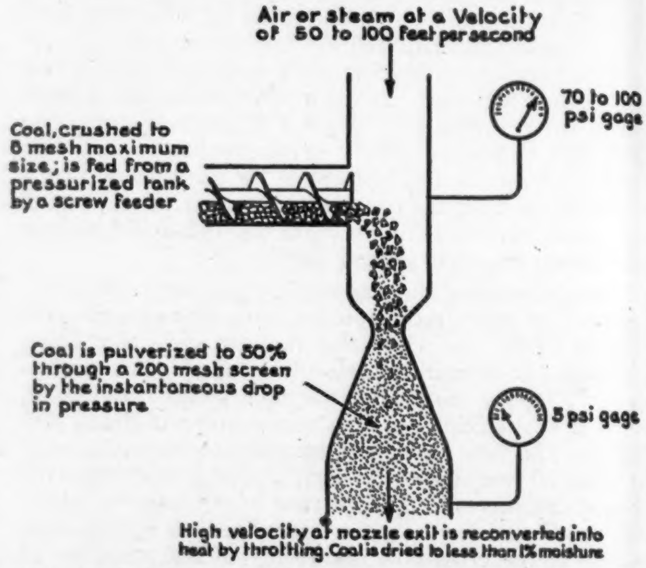
The Coal-Handling System

The method of pulverization which is under active consideration by the committee is the air-operated coal atomizer. This simple device requires approximately 1 lb. of air per lb. of coal, at a pressure about 80 lbs. per sq. in. above the combustor pressure. The supplying of this air by a small auxiliary compressor, probably of the reciprocating type, will take about 1.5 per cent of the shaft output of a gas turbine, but it will probably result in the lowest attainable overall pulverization cost.

In order to make the coal suitable for use with the coal atomizer, it must be crushed and dried, so that it can be fed from the pressurized storage tank. Since very large quantities of waste hot air are available from the turbine exhaust, it seems logical to use this air for drying the coal, and also for conveying the coal after it has been crushed. Consequently, the coal will be fed from the bunker through a riser section, from which it will fall into a small motor-driven hammer mill. In this mill, it will be reduced to –16 mesh, and tramp iron will be eliminated. The drying of the coal will be done by introducing heated air into the feeding system, and, since this heated air will pick up much of the fine coal in the process, the same air will also be used to sweep the bottom of the crusher, thus picking up the remainder of the coal, and carrying it to the pressurizing system.

The coal-handling devices will be operated under a slight suction, in order to eliminate leakage into the cab of the locomotive, and thus to maintain the desirable feature of cleanliness. The suction will be produced by a combined fan and dust catcher, such equipment being available in the form of the Rotoclone, manufactured by the American Air Filter Company, Louisville, Ky.

In order to be burned in the combustor of a gas turbine, the coal must be put under pressure. A number of different devices can be used for this purpose. Since the coal atomizer is to be used as the pulverizer, the maximum



The coal atomizer pulverizes the fuel as a result of internal explosions caused by the rapid pressure drop through the nozzle

pressure in the pressurized storage tanks will be 140 lb. per sq. in., and consequently the pressurizing device must be prepared to work against this pressure. A number of possibilities exist, including the use of the twin-tank system, the lock hopper, and the "coal pump." With the twin-tank system, while one tank is under full pressure, delivering coal to the atomizing air line, the other is isolated from this line and coal is entering the tank through the conveying line. Because of its relative simplicity, this system is likely to be used in the first coal-burning gas turbine system.

The lock hopper consists of two upper tanks superimposed upon a base tank, and is likely to be widely used for stationary gas turbines. The necessity for a considerable amount of head room, however, makes its use on the gas-turbine locomotive more problematical.

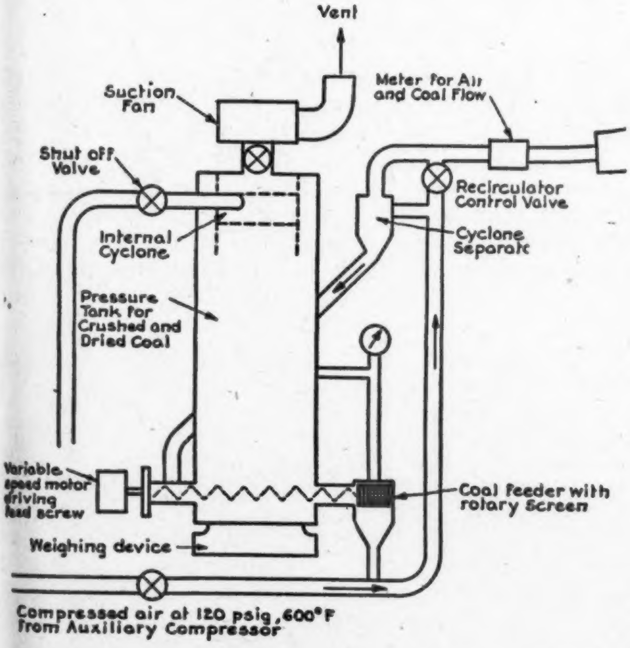
The coal pump consists of a screw feeder, operating at such speed that a continuously renewed plug is produced at the high-pressure end, which acts as a seal to prevent the leakage of air down the worm. This device has been under development both at the Institute of Gas Technology and at Johns Hopkins University, and it has been possible to pump coal at rates as high as 30 lb. per min. against pressures up to 70 lb. per sq. in. The Standard Stoker Company reports that, with a similar device, using improvements of their own design, they have been able to secure consistent operation against 90 lb. per sq. in. pressure. If this development can be carried to a commercially successful point, it will result in a great simplification of the coal-handling system.

The feeding of the coal from the pressure tank into the atomizing air line has in the past been done by means of a small screw feeder, operating at variable speed

Because the screw feeder, particularly at low speeds, is not too reliable, a drum-type feeder will also be investigated for this service. Such feeders have been widely used in the chemical process industry for accurately controlling the feed rate of granular materials.

Since the accurate control of the rate of fuel flow is of paramount importance in gas-turbine operation, it is probable that a secondary control system will also be developed. In this system, the screw feeder would deliver the crushed coal through a rotary screen, which would serve to eliminate oversized particles. The atomizing air, supplied from the booster compressor at a pressure of 120 to 140 lb. per sq. in. gauge, and a temperature as high as 600 deg., picks up the coal from the feeder, and carries it up to the recirculator control valve. When full coal flow is required, this valve is opened, and the coal thus passes to the coal atomizer and the combustor.

A coal-flow meter, of the type developed by the Battelle Memorial Institute, will probably be used to give continuous indications of the rate of coal and air flow. If, because of a sudden dropping of the load from the gas



The recirculation method for controlling the feeding of the coal

turbine, the fuel must be shut off instantaneously, the recirculator valve is closed, and the coal-air stream is directed through the cyclone separator. The coal is thus separated from the air and returned to the feed tank. The air passes on into the combustor, and thence to the turbine. Intermediate settings of the control valve will result in the by-passing back to the tank of any desired portion of the fuel. The master control of turbine power, in this system, would be the recirculator control valve, and this would be air-actuated through the governing system.

Pulverization and Combustion

Pulverization of coal can be accomplished by a number of different devices. The hammer mill and ball mill have been widely applied, and they are used almost universally for large power-plant applications. On the locomotive, the problem is complicated by the fact that it is desirable, for many reasons, to pulverize the coal while it is at full operating pressure. No pressurized pulverizers are on the market at the present time.

The Locomotive Development Committee has under active study the coal atomizer, a device first used at the Institute of Gas Technology in Chicago to produce finely pulverized coal for gasification. It consists simply of a nozzle which is inserted into a line through which flows compressed air at a pressure about 80 lb. per sq. in. above the discharge pressure. By causing the coal to pass through the nozzle with the air, pulverization can be accomplished through the tremendous number of internal explosions which take place when the air entrapped within the pores of the coal, seeks to expand as the pressure is reduced. By the addition of a simple attrition device, the product can be as fine as 80 to 90 per cent –325 mesh, with 5 per cent or less +100 mesh. Through the use of air at increasingly high temperatures, and by improving the attrition device, it is expected that the air consumption can be reduced below 1 lb. per lb. of coal.

Because of its simplicity and lightness, the coal atomizer appears to be the most suitable method of pulverization which has yet been proposed. Although its power consumption is higher than that used in the ordinary mechanical mill of like capacity, its simplicity and its ability to deliver coal at the proper pressure make it particularly attractive for this application.

The actual burning of coal under pressure is now receiving very active attention from the committee. Fundamental research on the burning of coal under pressure is being done at Battelle Institute, while various promising types of combustors are being tested at Johns Hopkins University. A large-scale pressure combustion laboratory is being installed at the Dunkirk Works of the American Locomotive Company.

The gas-turbine combustor is unique in that the amount of excess air is far greater than that encountered in any other fuel-burning device. In order to reduce the temperature of the products of combustion to a value of approximately 1,300 deg. F., which can be successfully used with available turbine materials, six or seven times the theoretical air requirement must be supplied. Approximately 10 lb. of air is an average theoretical requirement for bituminous coal. Since this same pound of bituminous coal will produce somewhat more than 1 hp. at the shaft of the turbine, it is evident that the actual air rate of about 60 lb. per shaft hp.-hr. will result in a great excess of air over the theoretical requirement. Obviously, if an attempt is made to burn the fuel directly in the total supply of air, the flame will be so chilled that the combustion efficiency will be very low, and the flame may even be extinguished. Consequently, it is necessary to have some form of inner combustion chamber, within which the coal, with about 40 per cent excess air, is completely burned. The remaining air is ordinarily used to cool the internal combustion chamber and to mix with the products of combustion after they emerge from this chamber. High rates of heat release can be expected in the gas turbine, because the oxygen concentration in the air is increased due to its higher pressure, and also because large quantities of excess air can be used to create a very favorable condition of turbulence.

In the development program of the committee, fundamental studies of the effect of pressure upon the combustion of pulverized coal are being made at Battelle Institute. With single-tube equipment, studies are being made to determine the flame speed and rate of heat release which can be anticipated when a pressure as high as 60 lb. per sq. in. gauge is used in the combustor. Thus far, heat releases as high as 2,000,000 B.t.u. per hr. per cu. ft. have been recorded.

Also under test at Battelle is a unique combustor, patterned after the Vortex combustion chamber originally

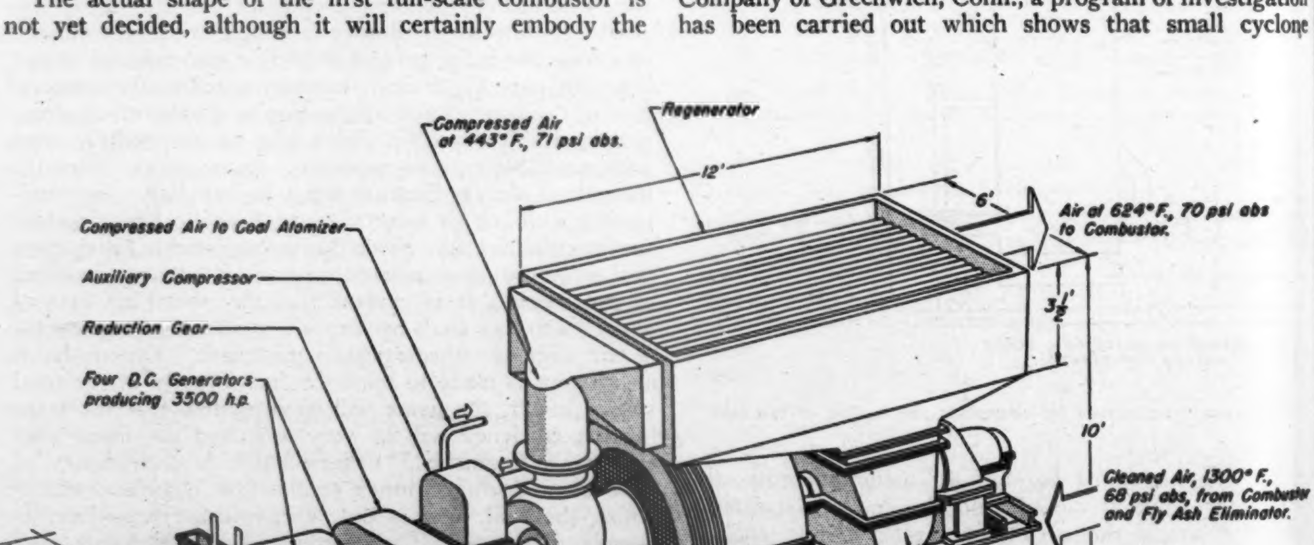
proposed as early as 1931 by the Fuel Research Board of Great Britain. In this combustor, the fuel is admitted through a number of feed pipes which are located about midway between the center and the periphery of a cylindrical combustion chamber. Air for combustion is admitted through a series of vanes, which cause the air to spin vigorously as it passes towards a centrally located outlet. The coal particles tend to be thrown outward by centrifugal force, while the drag of the inwardly spiraling air tends to carry these particles out through the outlet. Thus, particles of each particular size will automatically take up an equlibrium position, where the centrifugal force just balances the aerodynamic drag. A rotating fuel bed, suspended in rapidly moving air, is thus produced. The air for combustion and for cooling the Battelle combustion is supplied by the compressor of an aircraft turbocharger. The hot products of combustion, under a pressure of 10 to 15 lb. per sq. in. gauge, pass through the turbine of the turbocharger, giving up enough energy to drive the compressor, before being exhausted to the atmosphere. Ignition of the coal is obtained by means of a small pilot gas flame. It has been found possible to operate this combustor for long periods of time, with exhaust temperatures as high as 1,800 deg. F. After ignition has been accomplished, the pilot flame can be turned off, and combustion is maintained. A heat release as high as 4,000,000 B.t.u. per hr. per cu. ft. has been obtained with this unit, and it appears to have excellent possibilities for use as a gas-turbine combustor. Tests will shortly go forward on a much larger combustor, using a 10,000 cu. ft. per min. blower to supply the necessary air.

The actual shape of the first full-scale combustor is not yet decided, although it will certainly embody the principle of an inner shell, where the coal is burned completely, surrounded by an outer shell through which the cooling air circulates. The conception of the combustor will be similar to that which has been successfully applied in oil-fired gas turbines.

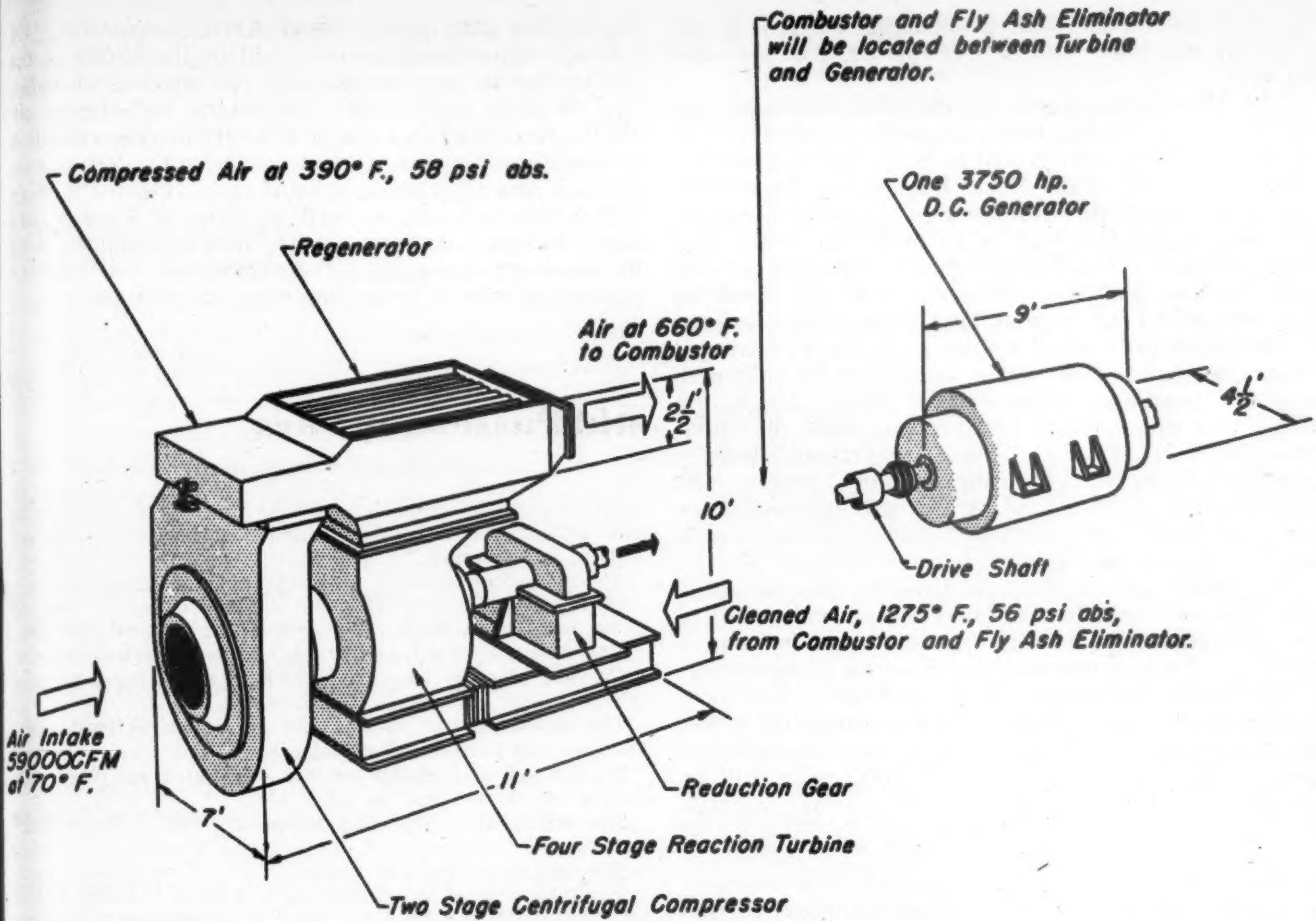
The removal of fly ash from the products of combustion is a matter of the utmost importance. Tests now under way at the Institute of Gas Technology have shown conclusively that, if they fly ash is not removed, the products of combustion are extremely abrasive even to the hardest materials now employed for turbine blades. If the fly ash, on the other hand, can be removed, to such an extent that only 5 per cent to 10 per cent of the original dust loading remains, and all of the particles above 10 microns (.025 in.) are removed, then the abrasiveness of this air-dust suspension is reduced to the point where it is not expected to be harmful to gas turbine blades. In studying the problem of removing fly ash from air at 1,300 deg. F., it was immediately apparent that the usual power-plant practice of employing the Cottrell electro-static precipitator could not be used. The temperature of the air is higher than that which can be handled in the electrostatic unit, and the size of such units is far greater than could be incorporated into a locomotive.

Filters of temperature-resistant materials are also not a practical method of ash removal, because of the fact that they would soon become clogged.

The use of a battery of small cyclone separators appeared at the outset of this investigation to be the only practical solution to the problem. In cooperation with the Aerotec Company and the Thermix Engineering Company of Greenwich, Conn., a program of investigation has been carried out which shows that small cyclone



The Allis-Chalmers gas turbine for the coal-burning locomotive



The Elliot unit for the coal-burning gas-turbine locomotive

separators produced by these companies can meet the requirements of gas-turbine service, and adequate evidence is available to demonstrate that a battery of the tubes operates in exactly the same manner as the individual tubes.

It has been demonstrated that the Aerotec tube can effectively remove as much as 95 per cent of the fly ash in a hot-air stream. As the temperature increases, however, the efficiency of the tubes decreases, but this decrease can be overcome by increasing the velocity of the air passing through the tube. For a given velocity, the pressure drop through the Aerotec tube varies directly as the density of the air. Thus, a 10-in. pressure loss at atmospheric pressure and 1,000 deg. F. corresponds to a loss of about 1 lb. per sq. in. at full-gas turbine operating conditions. Since pressure loss between the combustor and the turbine is very harmful to efficiency, it is expected that a compromise will be established, resulting in the removal of about 90 per cent of the fly ash, and restricting the pressure loss to about 1 lb. per sq. in.

Variations in dust loading over a wide range are not harmful. It is expected that, with 10 per cent ash in the coal, the dust loading coming to the separators will be about 2 grains per cu. ft. This can easily be reduced to 0.2 in the air coming from the separator.

Dust tests are being carried out, using a number of turbine-blade materials as test specimens. Uncleaned air is found to be extremely abrasive, and it is capable of drilling holes through flat test specimens in a short period of time. The abrasiveness of the air is reduced by a factor of at least 100 when the Aerotec separator is used to remove most of the dust, including all of the larger particles. During the coming year, work on the removal of fly ash will be continued, to test other promising types of cyclone separators, and to determine the economical limits beyond which it is not necessary to go in the removal of fly ash.

The disposal of the fly ash after it has been separated from the products of combustion is also undergoing serious study. It has been recommended that sufficient capacity be carried on the locomotive to render unnecessary the discharge of fly ash between locomotive terminals. The dumping of the powdered ash overboard at random cannot be tolerated, because of the fact that it would find its way into the air-conditioning system of the following cars, as well as producing a nuisance along the right of way. The fly ash could be discharged in the form of slurry if adequate water were available, but this would necessitate the carrying of an unnecessarily large quantity of water. Compacting of the ash and discharging it in the form of pellets would produce a hazard at high speeds.

The use of fly ash for rail sanding has been suggested, and it is under study at Purdue University, using a regular brake-testing machine. It is probable that, on the first experimental locomotives of the committee, ash storage capacity will be provided in which the ash resulting from the full load of coal can be accommodated, without the necessity of intermediate disposal.

Two Gas Turbines Ordered

The gas turbine forms a particularly effective prime mover for locomotive service because of its extremely light weight and relatively small size. Turbines proposed by the Allis-Chalmers and the Elliott Companies are now on order, and delivery is expected late in 1947. Each turbine will be capable of producing at least 3,750 shaft

hp., and the full-load coal consumption of each is considerably less than 1 lb. of 13,500-B.t.u. coal per shaft hp.-hr.

The Allis-Chalmers unit uses the axial compressor, the efficiency of which has been adequately demonstrated in many oil-refinery units as well as in the high temperature experimental unit in the Naval Engineering Experiment Station at Annapolis. Efficiency on similar compressors has been reported as high as 85 to 86 per cent. Five stages of reaction blading will be used in the gas turbine, and the four 1,000-hp. generators will be driven at approximately 1,000 r. p. m. by a single reduction gear.

The Elliott turbine will employ a two-stage centrifugal compressor, which will enable the unit to be built with only two bearings. Because of its unique design, the Elliott unit will eliminate high-pressure seals, thus compensating in part for the lower compressor efficiency which is to be expected from the centrifugal design. The Elliott unit is characterized by extreme lightness, since the prime mover and generator together will weigh only about 17 lb. per hp.

The actual design of locomotives to use the Allis-Chalmers and the Elliott turbines will be undertaken in the near future by the three major steam locomotive builders. A set of tentative specifications has been suggested by the Mechanical Advisory Board. The locomotives will be double-ended, thus eliminating the necessity of turning them at the end of a run. A maximum range, without refueling, of about 1,000 miles will be provided. A train-heating boiler of conventional type will be used, and the oil supply for this boiler will also be used as pilot fuel in the main combustor, and as fuel for the small auxiliary Diesel engine which will be used to start the main turbine. The conventional direct-current transmission system will be controlled by the engineman in a manner quite similar to that now used on the Diesel-electric locomotives.

It is expected that the duties of the fireman will be no more arduous than those which he now performs on the Diesel. The operation of the coal-handling equipment will be almost entirely automatic, and there will be very little for the fireman to do in the operation of the gas turbine itself. Conventional air-brake equipment will be used, with the air compressor driven from the main power unit. A small auxiliary generator will be used, together with a battery which will provide power during periods when the main turbine is not in operation. Serious thought will be given to the use of alternating current as a power supply for the auxiliaries, in order to eliminate the maintenance which would otherwise be necessary for the direct current motors which would be used to drive the coal-handling equipment.

Wind-tunnel tests will be conducted in the near future to determine the best shape for the locomotive, bearing in mind that approximately 100,000 cu. ft. per min. of air must be taken in to supply the main turbine and the traction-motor cooling requirements. Induction of this air at the proper place on the surface of the locomotive may result in a useful reduction of the power required at high speeds.

Future Developments

In looking towards the future, it can be predicted that larger units, with two turbines, capable of producing 6,000 rail hp. or more, will be in use. The new mechanical transmission, when it has been sufficiently developed, will remove the necessity of using the heavy and expensive electrical transmission which the first units will employ, and a considerable saving in efficiency at high loads will also result. The first cost of such locomotives, when quantity production is reached, should be considerably lower than that of the Diesel-electric locomotive. Of primary importance, however, will be the ability of the gas turbine to burn virtually any fuel which is available. For Western roads which customarily burn heavy oil, the gas turbine offers a chance of a very marked reduction in operating expenses, without sacrificing the convenience which is now expected from liquid fuels. For the Eastern and Southern roads, as well as those of Canada and many foreign countries, the gas turbine equipped with the necessary apparatus to burn solid fuel will form an economical answer to the motor power question.

Old Passenger Cars

(*Continued from page 614*)

powered units, an engine generator is also applied. Nearly all cars worthy of other than scheduled maintenance are supplied with an axle generator.

There are three types of air-conditioning, namely electro-mechanical, steam-jet, and self-powered. The choice is reserved to the individual railroad, whose needs dictate the type to be used.

The choice of roller bearings is left to the individual railroad.

Grinding of wheel treads to concentricity contributes to good riding qualities regardless of truck design.

The removal of the monitor roof contributes to outside appearance, and reduces future maintenance.

Modern sash—viz., double breather, dehydrated, and other such designs can be salvaged for other uses.

Side skirts, while improving appearance, add to maintenance costs.

Old rigid steps should be retained.

The application of air-conditioning is a *Must*. All that is lost by air-conditioning a car is the labor, as the material is salvageable. Air conditioning (cooling) produces more favorable passenger reaction during the months that travel is heaviest, than any other improvement.

The use of quality paints is economy. It costs no more to apply than a poor-quality paint and the resultant better service and appearance far offset the additional cost of the quality material. This item should be noted by the purchasing departments.

Your committee takes the stand that the conventional passenger car should be maintained as befits its condition rather than its age, its construction rather than its weight, and finally its cost of rehabilitation as against the cost of a new car. The foregoing recommendations illustrate its possibilities.

Discussion

In answer to a question, Chairman Barrer said that the committee feels there is a definite trend towards modernizing all passenger cars of sound-construction, although this equipment should be confined to local and relatively short runs, new lightweight cars being apparently essential for high-speed transcontinental trains.

President Cheshire pointed out that the decision to retire or modernize old conventional passenger cars has a direct bearing on future railway operating costs and service.

One member said that action must be taken quickly to hold traffic and another that the modernization of existing air-conditioned cars is essential owing to the impossibility of getting enough new cars.

The report was signed by Chairman W. C. Barrer, assistant superintendent car shops, C. & N. W., Chicago; L. A. McAllister, mechanical engineer, Alton, Chicago; A. W. Clarke, assistant general mechanical engineer, American Car and Foundry Company, St. Charles, Mo.; J. E. Candlin, Jr., assistant to chief engineer, Pullman-Standard Car Manufacturing Company, Chicago; E. L. Estes, district manager transportation, E. I. du Pont de Nemours & Co., Inc., Chicago; E. M. O'Brien, technical advisor, The Sherwin-Williams Company, Chicago; G. Coleman, vice-president, Williams-Haywood Varnish Company, Summit, Ill.; H. L. Holland, assistant mechanical engineer, B. & O., Baltimore, Md.; H. G. Moore, assistant superintendent car department, A. C. L., Wilmington, N. C.

EDITORIALS

Electrical Reports Indicate Future Trends

The October meetings of the two A. A. R. Electrical Sections, reported in this issue, were eminently successful. The Railway Electric Supply Manufacturers Exhibits were of exceptional interest. This might be considered obvious comment, as it has been five years since the Sections held regular meetings and seven years since there has been an R. E. S. M. A. exhibit. But such a long recess can cause disintegration of the best of organizations and the dislocations of war have left other groups without reason for existence.

To the electrical departments, the war has served as a powerful stimulant. Applications of equipment have been delayed and many new and improved things developed. The associations have been held together, and after five years have come back with renewed energy.

As might be expected, a relatively small part of the reports concerned the setting up of recommended practices, and although one report states that the committee was handicapped by manufacturers being reluctant to disclose new ideas they are developing, the reports as a whole include a wealth of new information.

If, for example, the Mechanical Division reports on car electrical equipment and car air-conditioning equipment are put together, they show new developments which begin with power supply and batteries, and include ramifications of power conversion, air-conditioning, refrigeration for food preservation and drinking water, controls for air conditioning, electronic air filtration, odor elimination and lighting. To this list the exhibits added other developments which will undoubtedly be incorporated in railroad service.

From this it would appear that Diesel power plants as well as propane-driven units will offer effective competition to axle generator drives, particularly on cars having heavy power demands. One railroad will equip 300 cars on which a.c. power, derived through the use of an amplidyne inverter, will supply power to nearly all equipment on the car except the compressor. With the possible development of suitable sealed compressor units, the use of a.c. power for compressor drives may be considerably extended over the few present applications. Mechanical refrigeration will almost certainly take over much of the cooling now done with ice for food preservation and drinking-water cooling. Air-conditioning controls used with reheat for dehumidification may effect refinements which will place the results above passenger criticism. Similarly, electronic and activated carbon filters are available which can effectively dispose of objectionable air conditions. Standards of lighting by the use of more fluorescent lighting can do much for car appearance and passenger comfort.

These are only a few things which indicate the present trend, but since they represent basic improvements, it seems obvious that the work to be done on new and existing equipment is just starting.

Oil Is Oil And Coal Is Coal

For a considerable number of years the Committee on Fuel Records and Statistics of the Railway Fuel and Traveling Engineers' Association has been actively engaged in studying the problem of developing some uniformity of practice in the matter of converting fuel oil and electric power consumed in railway motive power into terms of equivalent pounds or tons of coal. Some of its reports have pointed out the wide variations in the conversion factors used by different railroads and it has been working toward the development of some agreement on a more uniform formula or set of formulae for use in this connection.

In its 1941 report the committee defined a consistent equivalent value as one that would produce a fuel unit in pounds of coal per thousand gross ton-miles of the same order of value as that produced on the same territory by coal-burning locomotives in the same kind of service, from which it was deduced that the conversion factor should be such that a road using electricity, fuel oil, gasoline, or Diesel fuel could at any time return to the use of coal without affecting the value of the fuel performance units on the territory in question. To meet these requirements the committee suggested that the B.t.u. per ton and per gallon, respectively, of the two types of fuel be multiplied by the per cent of the total fuel disbursement for the service actually used on the road and the per cent of the combustion efficiency with which the potential heat in the fuel is released. Thus, in one example cited 0.8 of the heating value of a ton of coal is equated to the entire heating value of a gallon of oil to arrive at an equivalent of 148 gallons of oil per ton, whereas a direct comparison on the basis of overall consumption irrespective of relative efficiency would produce a ratio of 185 gallons of oil per ton of coal. Assuming an operation consuming 8 gallons of oil per thousand gross ton-miles, the equivalent coal consumption in the first instance would figure up to 108 lb. per thousand gross ton-miles and in the second to 86.5 lb.

The question raised by this comparison is, why should the performance of the oil-burning locomotive, either steam or Diesel, when stated in terms of pounds of coal, be handicapped by having to compensate for the lower efficiency of the coal-burning locomotive? It illustrates the difficulties of arriving at a formula which will be universally satisfactory.

There was a time when coal was so nearly the universal locomotive fuel and what oil was used was burned in the steam locomotive firebox that the small significance of the exceptions and the desire for a single statistical unit, no doubt, justified the practice of setting up statistics in terms of coal alone. However, that day is now past. The proportion of Diesel locomotives is increasing and, although the number in road service is still small, there are several large fleets of these locomotives which play very significant parts in conducting the transportation of the roads on which they operate. The performance of these locomotives and the amount of fuel oil consumed will undoubtedly be a matter of continued interest to the entire railway industry and to the public as well.

The OS forms have kept pace with these changing conditions but each group of fuel figures on Form OS-E still ends with the calculation by which the total consumption of all fuels purports to be expressed in terms of tons of coal. With the possible exception of "Other Fuels" (Items 2-06, 2-13, and 2-23), the coal equivalent of which amounts to less than one-tenth of one per cent of the actual coal consumption, why continue to equate fuels in terms of tons of coal according to a formula which someone on each railway considers applicable to its local conditions? How can quantities so arrived at have any statistical significance? If there must be such a total, why not arrive at it by dividing the average cost of a ton of coal on the railroad or in the territory under consideration into the total cost in dollars of all fuels consumed? This, at least, possesses the virtues of uniformity and simplicity.

Light Repair Tracks Taken Out of the Mud

One of the most forward-looking reports, presented at the Car Department Officers' Association meeting at Chicago early in September pertains to light car-repair-track location, lay-out, equipment and operation—a rather full coverage of the subject. One member described the report as a constructive effort to take light repair tracks "out of the mud" and organize them on a modern, efficient, production basis which should do much to reduce the time and cost of freight-car repairs and expedite railway service.

Obviously, the first consideration is location of the repair tracks with respect to the train yard to minimize switching and save time in placing bad-order cars where they can be quickly and suitably repaired. This factor is so important that railroads may well consider relocating certain light repair tracks which are now too far away or inconveniently placed, owing to changed operating conditions or other reasons. A location specified 50 years or more ago is no assurance that this position best meets modern requirements.

In this connection, the lay-out of the repair tracks and necessary offices, tool- and material-supply buildings is another factor which should be restudied in the light of present needs. Possibly slight and relatively inexpensive changes may effect real economies. Similarly, as suggested in the report, the kind of tools, equipment and method of operation deserves earnest consideration to discover what improvements can be made.

The report suggests, and in fact urges, the extension of "spot system" repairs to light repair tracks and there is a definite need for more specific information as to just what can be accomplished along this line. Theoretically, at least, it should be possible to concentrate the actual work of making light repairs in a restricted area, say three or four tracks wide and long enough to accommodate about four cars.

This concentration of work would permit supplying power jacks and wheel-change equipment, also other tools, repair materials and men in a comparatively small space, where the work could be more effectively supervised and much time and effort saved, as compared with doing the same work on cars spread over long repair tracks. In this connection, it has been suggested that, by placing bad-order cars on the repair tracks once or twice a day with the locomotive switcher, subsequent car movements to and through the repair "spot" can be effected by a car puller or tractor which will give the car department better service and save switching.

One thought, considered by the committee but not included in its report this year, was the possibility of covering the repair "spot" with a light shed or building, dependent upon climatic conditions, as a protection against inclement weather. It would not be feasible to house present long conventional rip tracks, but with the work concentrated in a smaller restricted space, why couldn't this be done? In some parts of the country, a roof with open sides and ends would furnish protection. In others, a light steel building would be required and in the north the building would need to be heated.

Railway light-repair tracks must be brought up "out of the mud" to the fullest extent practicable by installing hard-surface roadways and motorized equipment for the rapid, safe movement of both men and materials. Why not go one step further and get the important increase in production which can be secured by protecting men from the weather. One railroad study shows that car-repair work is slowed up as much as 50 per cent in extremely cold weather, and that there is definitely reduced output in cases of snow, sleet, rain, or temperature below 30 deg. F., even when the weather is clear. The loss is at least 10 per cent whenever there is heavy rain, dust or intense heat. And there is the often serious delay and cost of snow removal.

Providing it is practicable to concentrate light car-repair operations in a relatively small space, as suggested, it is thought that specific dollars and cents savings as a result of increased production will pay large dividends on the cost of any building structures required to protect the workers. Moreover, it is not unreasonable to assume that a better class of more-skilled carmen can be attracted and young men held in the service with improved working conditions. Regardless of the type

of improvements made, other parts of the railway mechanical plant are being streamlined and brought up-to-date and it is obvious that light car-repair tracks and their operation also deserve appropriate action.

Domeless Boilers

One of the more recent changes in steam locomotive boiler design is the elimination of the steam dome, a development that merits the consideration of all boiler designers. The simplification of any structure is always welcome and getting rid of the steam dome should make no one unhappy in the boiler shop for the fabrication and attachment to the boiler of a cylindrical steel part, one end of which had to be developed to the contour of the intersection of two cylinders, created a problem in laying out and a headache for the boilermaker in fitting-up. It reduces cost and weight and permits larger shells within the same clearance limits.

The necessity of keeping within the clearance limits was the main reason for designing the boilers of the New York Central's Niagara class locomotives without steam domes, a departure from conventional design that has proven to be entirely satisfactory in the service performance of these motive power units. The Canadian Pacific, having operated five domeless boilers on 4-4-4 type locomotives since 1936 and having received two domeless all-welded boilers early this year, has indicated that all new boilers will be designed without steam domes. The six all-welded boilers ordered for the Chicago & North Western also will be fabricated without steam domes.

At the recent annual meeting of the Master Boiler Makers' Association, it was pointed out that a study of the conditions existing inside a boiler while generating steam showed that the steam dome was not required for the delivery of dry steam to the dry pipe unless foaming became excessive. The observation also was made that with excessive foaming the lack of a steam dome had no detrimental effect because the dome has inadequate capacity to handle the foam. The chief mechanical engineer of one railroad has determined that the principal factor involved in designing a boiler without a steam dome is the location of the steam slots in the dry pipe as near the center of mass of the boiler water as practicable. At that point the effect of the surging and movement of the water would be least and therefore the possibility of carryover would be reduced. Other than a few precautions of this nature that are relatively simple of solution there are apparently no good reasons for continuing to use a boiler part the function of which can be defended so little on the basis of usefulness.

The simplicity of conventional steam locomotives has always been an inherent advantage of that type of motive power and the elimination of any part that is superfluous will improve that advantage. If it also has a beneficial effect on costs, construction and maintenance there should be no hesitancy in its adoption.

Classified Repairs For Diesel Locomotives

At the annual meeting of the A. A. R. Mechanical Division in Chicago in June, a sub-committee of the Locomotive Construction Committee offered a plan for a system of classified repairs to Diesel locomotives. What little discussion there was of the subject at that meeting indicated that the membership was not greatly interested in maintaining Diesel-electric power on the same general classified repair basis as has been the custom with steam power for many years. The feeling at that meeting, if a rather limited expression of opinion can be accepted as a guide, was that the shopping of Diesel-electric locomotives on a mileage basis for general repairs is not practical.

Either by design or coincidence there was also a committee report presented at the annual meeting of the Locomotive Maintenance Officers' Association in Chicago a month later which not only raised the question again but went so far as to recommend the establishment of a system of repair classification for Diesel-electric locomotives patterned directly after the classification for steam locomotives adopted by the railroads in 1924, and further outlined what, in the opinion of the committee, such a classification should be. In the discussion of the L. M. O. A. report at Chicago one chief mechanical officer remarked that "it begins to look as though we have made a mistake in ever letting a steam locomotive man have anything to do with a Diesel" for "now they want to handicap the Diesel with the same time consuming shopping system that has reduced the serviceability of steam power."

Another chief mechanical officer has since expressed to us the opinion that regardless of the general feeling of the members present at both of the Chicago meetings there is considerable merit to the proposed plan to shop Diesel-electric locomotives on a classified repair basis; that while locomotives of one type may be of such construction that they can be maintained on a "running repair" basis without shopping periods for general repairs it is decidedly to a railroad's advantage to shop the locomotives of another type on a mileage basis.

It is apparent that, for one reason or another, only one side of this important question has been brought out and, while an observer at either of these meetings might gather the impression that the classified repair system had no application to Diesel power at all, the entire story has not yet been told. One of the major advantages of Diesel-electric power is the ability of the railroads to use it day in and day out and both the operating and mechanical departments will oppose drastically any move to impose any system of maintenance that will affect utilization adversely. If, however, the classified repair system can reduce the cost of maintenance, and at the same time require no increase in out-of-service time over the running repair basis then by all means every railroad must, of necessity, give consideration to the question of a classified basis for general repairs.

With the Car Foremen and Inspectors

Car-Repair

Automotive Equipment*

A study of types which save time in train yards, at light repair tracks, in repair shops, and when repairing cars between terminals

The familiar saying "Necessity is the Mother of Invention" has never been more applicable than during the last few years during which car department supervision has been under constant pressure because of the critical situation with regard to time, labor and material. As a direct result of this condition, numerous time and labor-saving devices have been developed without which we would not have been able to "Keep 'Em Rolling." Many of these developments have been in the field of car department automotive equipment.

The speed and maneuverability of rubber-tired automotive equipment has made it possible to place repair material at the car in but a fraction of the time formerly used, and has substantially reduced the cost of material handling and delivery on a unit basis.

C. C. Cowden,
Chairman

In order to better cover the general subject, your committee has divided its study into three classifications; namely: (1) Car-department automotive equipment for use in train yard and on the light repair track, (2) for repairing cars set out between terminals, and (3) in heavy repair shops and on the stripping track.

There are three types of equipment which we believe are well adapted to repair-track and train-yard use: Three-wheel, pneumatic-tired delivery truck with low flat deck; small lightweight tractor with pneumatic tires; swing-boom tractor crane with telescopic boom.

The three-wheel, flat-deck truck is available in various sizes which range from ½ ton to 1 ton in capacity with a minimum deck-loading surface of 12.8 sq. ft. There are many advantages to be had from the use of this type of truck. Because of the single front wheel, the truck can be turned completely around in a very small space. The over-all width, being less than 3 ft. 6 in., makes it possible for the truck to go through narrow passages on material storage platform and also to operate safely between tracks when delivering material to individual cars on the repair track or in the train yard. The low deck tends to reduce heavy listing to a minimum. The light construction makes it possible to drive this unit with a one-cylinder motor, the average fuel consumption being about one gallon of gasoline per eight-hour day.

In selecting equipment of this type, consideration should be given to the type of road bed over which it will be operated. If the repair track has cement roadways, the ½-ton unit with single rear wheel is usually found to be adequate. If the truck is to be operated over cinders and rough ground it would be advisable to select the one-ton unit with dual rear wheels as this will result in better performance, particularly during the winter months.

The maintenance cost of this equipment is very low, general lubrication being required after approximately 40 hr. of operation and change of crankcase oil after each 25 hr.

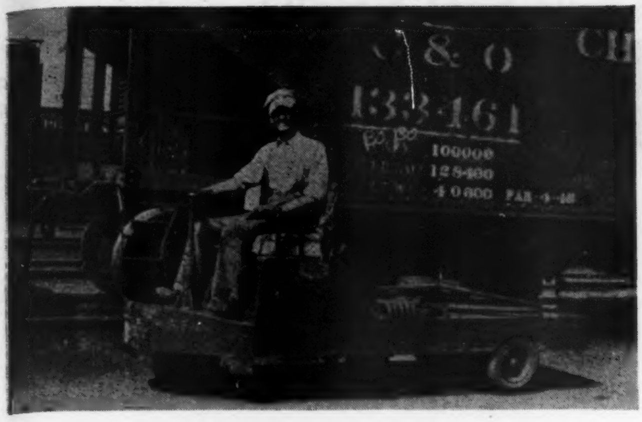
Lightweight Tractor with Pneumatic Tires

The ordinary type of shop tractor with pneumatic tires is used mainly in pulling four-wheel wagons loaded with heavy steel parts, lumber, scrap, etc. This tractor should also be equipped with a heavy duty bumper for use in shoving empty cars and other units of shop equipment. The maintenance of this type of tractor is a routine procedure, the important thing being that manufacturer's recommendations with regard to lubrication be strictly adhered to.

The swing-boom tractor crane with telescopic boom, has come into common use during the war years. This piece of equipment is adapted to many of the uses of the ordinary tractor but has proved to be particularly valuable in the changing of wheels. By using this type of boom tractor the operator and the helper can pick up one or two pairs of mounted wheels from the storage tracks, deliver them to the dismantled truck and lower them onto the track in the position required for the mounting of truck sides. Scrap wheels can then be picked op from the track and delivered to the scrap-wheel track. This does away with delivery and handling of wheels by mechanics and eliminating all heavy lifting and use of jack handles and wheel sticks. This outfit can also be used in hanging doors, lifting couplers to position for application, loading and unloading heavy material from storage platform to material wagons, loading and unloading material from cars, and loading scrap.

This type of equipment is available in sizes varying from 5,000 lb. to five-ton boom capacity, the lighter unit usually being adequate for light repair track use, particularly where cement roadways are available. If it is necessary to use equipment on rough ground where the going is hazardous during the winter months it can be procured with crawler drive and selection should be made according to local conditions. This equipment is simple to maintain, it only being necessary to follow instructions furnished by the manufacturer with regard to lubrication, etc.

* From a paper presented at Chicago on September 6 during the annual meeting of the Car Department Officers' Association.



A three-wheel material delivery truck

Repairing Cars Set Out Between Terminals

Repairing cars set out between terminals is primarily a problem of transporting repairmen, tools and material to remote sidings where temporary repairs can be made so that the car can be moved to the shop.

Various means of transportation have been employed in doing this job, ranging all the way from private automobiles to 10-ton trucks, the committee having received favorable reports on the following: One-half ton pick-up truck with cab; one-ton stake body with benches on the deck for seating passengers; station wagon equipped with heavy-duty springs in rear; jeep, with four-wheel drive and small stake body.

In selecting equipment for the work, local conditions with regard to the amount of right of way to be covered should govern. In other words, the more territory involved, the greater number and complexity of the problems. However, it seems likely that any of the four pieces of equipment, listed in the foregoing paragraph, would furnish speedy and safe transportation of hand tools, jacks, blocking and material necessary for minor repairs to the desired location.

It is regrettable that this does not constitute the entire problem so that this phase of our study could be concluded at this point but we have all, at one time or another, been confronted with the problem of cars being set off at remote sidings with defective wheels, badly cut journals, broken truck bolsters, broken truck sides, and numerous other defects, including derailments which had to be handled where located.

The customary procedure in cases of this kind has been to load the wheels, bolsters, truck sides, or whatever material is required, into a revenue car along with hand tools, jacks, blocks, etc., and have the local set the car off on the siding next to the bad order car.

When notice has been received that the car has been spotted, usually the following day, repairmen are dispatched to the scene by whatever means may be available, and upon arrival are confronted with the task of unloading and handling the heavy parts by hand and reloading, if possible, the defective parts removed. This is not only dangerous and hazardous work, which may result in serious personal injury, but usually results in a delay to equipment of from 48 to 72 hr., in addition to tying up a revenue car for three or four days. The above, coupled with over-time and cost of handling and switching of the car carrying material, makes this a very costly operation.

We are happy to report that important steps have been taken toward a satisfactory solution of this problem by several roads, the general idea being the same, that of mounting a crane or cranes on a standard truck chassis, the power being furnished by the motor. At least one truck of this nature is now in use which has a crane mounted on each side of the deck to the immediate rear of the cab, each crane being able to raise and hold a pair of mounted wheels and swing outward in an arc of approximately 100 deg. from the center of the deck. Deck space is sufficient to accommodate tools, jacks, blocking, etc., as well as two pair of mounted wheels. The cab will seat three men comfortably.

Two roads, which have this type of truck stationed at large terminals, have been kind enough to furnish your committee with some data regarding savings in time and expense which have been accomplished through its use. In both instances the equipment operates over a large territory. The figures shown in the table cover wheel changes only and include both long and short trips.

The figures indicate that a truck of this type can be made to pay big dividends in both time and money saved, provided the territory where it is stationed is extensive enough to require several pairs of wheels to be changed at outside points each month.

Cost of Wheel Changes Using Motorized Truck

Average cost per hour, equipment and driver only	$7.50
Average time elapsed from time equipment is loaded at shop until return	4 hr.
Average delay to equipment set out	12 hr.
Average cost of changing wheels at outside points, includes use of truck and labor only	$50.00
Number of trips per month	8 to 15

We are not able, with the information at hand, to make any definite recommendations as to just how often this equipment would have to be used to make it a paying proposition and as to just what type and capacity of truck and crane should be used for different sized territories. It has come to our attention, however, that in one city where two roads have terminals, a private concern has, under the supervision of railroad officials, built two of these outfits and rents them out at $7.50 per hour, including the driver. We are told that this system is working out to the complete satisfaction of both parties.

Automotive Equipment for Heavy Repairs

In considering the third phase of our study, we would call your attention to the three types of equipment which were recommended for use on the light repair tracks; namely, a three-wheel, pneumatic-tired delivery truck, a small lightweight tractor with pneumatic tires and a swing-boom tractor crane with telescopic boom. The above-mentioned equipment is equally well adapted to heavy-repair program work and can be used for the same general types of work as previously shown, the swing-boom tractor crane being particularly valuable in shops where overhead cranes are not available, as steel sheets and prefabricated parts can be raised, swung into position and held while fit-up bolts are applied. The telescopic boom makes it possible to raise and swing with material at any desired height up to approximately 18 ft. above rail height.

A crawler crane of five tons capacity with telescopic boom and a swing radius of 180 deg. has proved its value on the stripping tracks. The full track makes it possible for this equipment to be operated over all kinds of ground as well as the ever present litter to be found where cars are being stripped. This type of equipment is available with generator and magnet attachments which aid materially in loading scrap.

Another piece of motorized equipment which has proved valuable for general shop use for all departments is a five-ton crane with magnet attachment mounted on a truck chassis. This type of crane is easily moved from one point to another around the shops, and from one point to another on the highway. Here

A common type of shop tractor

Crane-equipped truck for changing wheels at outside points

again the practicability of using the equipment would be governed by purely local conditions, the big advantage over the usual type of crane which operates from the rails being that no delay is occasioned by waiting for switching.

There are, of course, many other types of automotive equipment which are giving performance of a caliber which justifies their purchase and maintenance, and much new equipment is now on the market, which has not to date proved its worth to the extent that we felt it should be covered in this report.

Central Automotive Servicing Garage

In addition to what has already been said with regard to maintenance, our study indicates a trend toward the establishment of a central garage for servicing and repairing automotive equipment for all departments at the terminal, the usual plan being to have operators run their units into the garage at the close of the day trick, after which competent mechanics check oil, gas, tires, and refuel for the next day's work, as well as making minor repairs and adjustments as indicated. The force can be adjusted so that ample time can be allotted to major overhaul jobs when required. This system makes it possible to keep accurate records of fuel consumption and normal operating costs and tends to eliminate guesswork with regard to maintenance cost, as well as greatly to increase the efficiency of operation. In the opinion of the committee, this practice should be followed wherever the size of the terminal warrants it.

Another item which is directly related to maintenance is that of the condition of shop grounds, with particular attention to roadways and storage platforms. It is quite generally conceded that concrete roadways and storage platforms will pay for their construction in a short period of time through the increased efficiency of operation and reduced cost of maintaining equipment. In order to obtain the maximum of efficiency where concrete roadways are available, all equipment from heavy tractors to wheelbarrows should be equipped with pneumatic tires to facilitate speed and ease of operation. This committee is of the opinion that money spent on concrete roadways and material storage platforms will pay big dividends, and should be made available wherever possible.

Discussion

In discussing this report, D. J. Sheehan, C. & E. I., said that it is obviously uneconomic to spend large amounts of money for concrete roadways at small repair tracks where only one or two small units of motorized equipment are required to operate. He suggested that such equipment be developed to operate satisfactorily on gravl roadways at smaller repair points and also that rail cars for handling car materials and inspectors be replaced by automotive equipment for use on highways which railroads, as well as the public, help maintain.

The report was signed by Chairman C. C. Cowden, assistant superintendent car department, New York, Chicago & St. Louis, Cleveland, Ohio; J. G. Rayburn, superintendent car shops, Chesapeake & Ohio, Russell, Ky.; A. C. Schroeder, assistant to superintendent car department, Chicago, Milwaukee, St. Paul & Pacifice, Milwaukee, Wis.; G. D. Minter, division car inspector, Norfolk & Western, Portsmouth, Ohio.

Large Spot Welder Speeds Production

Development of a multiple spot-welding machine, one of the largest built up to date, has been announced by the Pullman-Standard Car Manufacturing Company. The new machine is in operation at the company's plant in Chicago where welding engineers expect it to increase production about 30 times over former processes.

Weighing more than 90,000 lb. the machine was built for Pullman-Standard by the National Electric Welding Machines Company, Bay City, Michigan. It was developed after extensive study of all existing methods by development engineers of both Pullman-Standard and the builders.

The machine will be used primarily to weld stiffeners to the interior of passenger car sides to give them the straight, sleek appearance dictated by today's flashy-

Electric eye arrangement in the multiple spot welder—An almost unlimited number of combinations may be worked out, making the machine entirely automatic

colored streamliners. The stiffeners, not visible from outside the car, are sheets of light-gage corrugated metal, welded inside the walls of the car to lend strength and smoothness, much on the same principle as the corrugation on the interior of a cardboard box, making it many times more sturdy than the wall alone.

The use of corrugated stiffeners in carbuilding was patented by Pullman-Standard in 1938 and the first system of fabrication employed single stationary spot welders making one weld at a time. These were used until 1942, when the war suspended all carbuilding. The principle of applying multiple spot-welding to this work was developed during the war period and, with the advent of post-war carbuilding, the new machine was built.

In operation, a metal table 30 ft. long and 10 ft. wide travels beneath a battery of 48 stationary welding electrodes. The work to be welded is laid flat on the table, which has been covered with a copper plate. As the table moves slowly beneath the row of spot-welding electrodes, it is adjusted to stop at proper intervals and the electrodes automatically lower, making contact with the work and securely welding the stiffeners to the car side. The electrodes then lift up and the table moves on to the next position, where the process is completed.

One of the large multiple spot welders used in building streamline passenger cars at the Chicago plant of Pullman-Standard

An electric eye arrangement makes the job of welding entirely automatic. Along one side of the table are drilled two rows of small holes about ¼ in. apart. The electric eye beam is directed from beneath the table, through these holes, and when striking a photo-electric cell above the holes, the circuit is completed which stops the table, lowers the electrodes, makes the weld, lifts the electrode and starts the table operation again.

By dropping loose rivets into all the holes not needed in the operation, the position of welding is preset. The table then moves along smoothly until an open hole passes over the light ray, setting the welding process into operation.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Value of Special Equipment

On March 7, 1945, a car belonging to the Chicago, Rock Island & Pacific was destroyed on the tracks of the Union Pacific. This car, originally built as a Class B automobile car in 1930, was remodeled in 1944 by the raising of the roof and the installation of special loading equipment for the sole purpose of transporting wing flaps of the B-29 airplane. The title to the special equipment was vested in the C. R. I. & P. although the cost of the equipment and the remodeling was borne by the shipper with the understanding that when no longer required its removal and disposal was to be the responsibility of the car owner. The shipper made a claim of $4,341.80 on the C. R. I. & P. as representing its loss and interest in the car due to being denied its use. The C. R. I. & P. made a claim against the U. P. of this amount plus the depreciation value of the car or $6,318.77. In its statement the U. P. contended that the conveyance of title to the C. R. I. & P. forfeits the claim of the shipper with respect to property damage and limits the shipper's claim to loss of use. The U. P. stated that since cars so equipped were idle most of the time since this car was destroyed, the destruction of the car did not result in loss of use and the shipper had no interest in the car and, therefore, no basis for claim on the C. R. I. & P. According to the U. P. settlement should be made on the basis of the depreciated value of the car plus the scrap value of the specialties or a total of $2,034.35.

In a decision rendered November 15, 1945, the Arbitration Committee said, "Increasing car height does not constitute rebuilding of car under Section E, and the device installed in car is not included among the additional allowances in Paragraph 9(c) of Section B, of Rule 112. Therefore, settlement should be made on the basis of non-rebuilt Class B box car at the A.A.R. reproduction price per pound applicable to this class of car per Section B, times the total weight of car at the time of destruction (including weight of the special device in question), less the depreciation per Section D from the date original car was built (June-1930) to the date car was destroyed, or $2,357.13." *Case 1816, Union Pacific versus Chicago, Rock Island & Pacific.*

Interpretation of Section 5, Rule 44

In September, 1944, the Terminal Railroad Association of St. Louis delivered tank car SHPX 22079 to the home point of SHPX cars, the Acme Tank Car Corporation, with one tank anchor broken and all bolts securing the other three anchors sheared off. In behalf of the car owner the Acme Tank Car Corporation made a claim for defect card protection upon the chief interchange inspector and later upon the Terminal Railroad Association of St. Louis, both of which were denied. The car owner, the Shippers' Car Line Corporation, claimed that the broken anchor and the three sheared bolts were equivalent to all the bolts being sheared as specified in Rule 44, Section 5, and on that basis believed defect card protection was in order. The request for a defect card was declined by the Terminal Railroad Association of St. Louis because all the anchor bolts were not sheared off and therefore the defects were not covered by Rule 44.

In a decision rendered April 11, 1946, the Arbitration

Committee said, "The shearing of the anchor bracket and part of the rivets between the anchor and the tank so that the anchor between the tank and underframe was rendered completely ineffective at the BR location is considered as being equivalent to shearing the bolts or rivets as contemplated in Paragraph 5 of Rule 44. Since the bolts were sheared off at the other three locations and the tank was shifted approximately eight inches, the handling line should furnish a statement to establish that the damage occurred under fair usage or issue its defect card to cover the damage. The contention of the Shippers' Car Line Corporation is sustained." *Case 1817, Shippers' Car Line Corporation versus Terminal Railroad Association of St. Louis.*

Claim for Wrong Repairs Not Upheld

The Cudahy Car Lines submitted joint evidence to the Terminal Railroad Association of St. Louis on June 14, 1944, alleging certain wrong repairs to car CRLX 6170 and requested defect card protection, which was refused. The Cudahy Car Lines claimed that the Terminal Railroad Association of St. Louis insisted on making repairs to this car more extensive than necessary to make the car safe for movement to the car owner's shops. The Cudahy Car Lines had authorized an expenditure of $35 for temporary repairs. Believing that it was impractical to put the car in safe condition for that amount of money the Terminal Railroad Association requested the Illinois Central, via whose lines the car would be routed home, to indicate the minimum temporary repairs that would make the car acceptable for movement. These repairs were reported as the splicing of two wooden center sills, renewal of wooden end sill and deadwood and the welding and replacing of metal draft arms. The Cudahy Car Lines did authorize these temporary repairs except for the splicing of center sills. The latter repair was made by the Terminal Association of St. Louis without charge because it believed that repair was necessary to make the car safe and it denied that any damage was done to the car in making the temporary repairs.

In a decision rendered April 11, 1946, the Arbitration Committee said, "The damage occurred in fair service. In order to get the car home the owner authorized temporary repairs which were made substantially as requetsed by owner and in a reasonably economical manner. A claim for wrong repairs in such cases is not proper. The contention of the Terminal Railroad Association of St. Louis is sustained." *Case 1818, Cudahy Car Lines versus Terminal Railroad Association of St. Louis.*

Frisco Builds Covered Hopper Cars

The illustration shows one of the 70-ton covered hopper cars which went into production in the Yale yards of the St. Louis-San Francisco at Memphis, Tenn., in August. These cars, produced at the rate of two a day, were constructed in the Yale yards from the ground up and placed in service immediately to handle cement, lime, sand and grain. One hundred of the cars were authorized for building under the initial construction program.

Eight 3-ft. square hatches on the steel roof of each car load two 946-cu.-ft. compartments. At the bottom of each car, four 13-in. by 24-in. openings, covered by gear-operated sliding hatches, facilitate unloading, and the hopper sheets slope so that the contents are quickly and completely discharged. The cars are equipped with metal running boards.

Each of the covered hopper cars is subjected to a water test simulating heavy rainfall to determine its ability to protect contents from rain or water damage.

In addition to these covered hopper cars, the Frisco recently completed 300 hopper ballast cars at its Yale yards.

Seventy-ton covered hopper car built at the Yale Yards of the St. Louis-San Francisco

IN THE BACK SHOP AND ENGINEHOUSE

Locomotive Washing And Stripping Rack

By the turn of a valve, the Union Pacific can now give its largest locomotive a chemical "shower bath" and cut to a fraction of its former figure the cost of stripping grease and paint from locomotives sent to the shop for repairs. This work is accomplished by means of an automatic washing and stripping rack, designed and constructed by two mechanical-department supervisors at the Denver, Colo., shops and subsequently also installed at the locomotive shops at Cheyenne, Wyo.

Before installation of this automatic washing and stripping rack, approximately 192 man-hours were spent dismantling necessary locomotive parts so that the cleaning might be thorough in all details. This stripping of a grease and dirt-encrusted locomotive was a slow process both because of the manual labor involved and the difficulty in keeping hands sufficiently clean to work efficiently. The dismantled parts were washed in a solution of caustic soda and oil distillate from a hand-carried spray, powered by steam pressure. After allowing the solution 15 to 20 min. to soften and emulsify the hard coating of engine grease, the dismantled parts were rinsed with a stream of hot water and steam. A second such treatment, though on a smaller scale, was then given to clean specific spots missed during the first application.

The spray pipes and nozzles, also bottom draining arrangement

The automatic washing and stripping rack now used on the Union Pacific is made of reclaimed sheet metal and pipe and comprises a narrow metal shed with an internal pipe system interrupted by literally hundreds of small pipe nozzles. With a locomotive in the shed, a chemical stripping solution, basically caustic soda, is pumped through the pipes and out the nozzles to spray the locomotive and remove both the grease and paint.

The construction of this washing and stripping rack was not an overnight job. Working without blueprints, with reclaimed materials, and during slack periods, it took nearly three years to complete the Denver installation in its final form and to get it working satisfactorily. When the Denver rack proved a success, another shed was built at Cheyenne and construction carried out under virtually the same limitations.

The building is 90 ft. long by 13½ ft. wide and 17⅓ ft. high and has a fixed closure at one end and a roll-top door at the other. It will hold any Union Pacific locomotive. Tenders are detached from their locomotives and processed separately. There are 1,350 ft. of pipe, ranging in diameter from 1 in. to 2¼ in., lining the interior side walls, ceiling and floor. The pipe system is studded with 860 nozzles, generally distributed and pointed so the spray hits all surfaces to be washed.

The cleaning agent used is a 4,000-gal. solution of

The Union Pacific locomotive washing and stripping rack

Spray jets are spaced and directed so as to reach all exterior locomotive surfaces

water basically caustic soda washing powder stored in a 5,000-gal. underground tank adjacent to one side of the building. The mixture is 10 ounces of powder for each gallon of water.

The solution is forced through the pipe system at a rate of 2,400 gal. a minute and at a pressure of approximately 50 lb. by a centrifugal pump, which is operated by an 80-hp. motor turning at 1,800 r.p.m. As the solution pours off the locomotive it runs into a drain in the welded sheet-iron floor and back into the storage tank for repumping through the pipe system.

An hour and 20 min. generally suffices to strip all grease and paint from the locomotive. The drain into the solution tank is then blocked and the locomotive is rinsed for approximately 35 min. with clear water projected either through the pipe system or from a hose. The rinse water, unable to enter the storage tank, drains off through the regular sewage system.

The grease and paint, removed from the locomotive, drain into the storage tank with the solution, but are held from being pumped back through the pipe system by a series of stationary screen baffles and a rotating screen baffle. When the operation has been completed, the solution is pumped by a small centrifugal pump, rated at 400 gal. per min. and operated by a 15-hp. motor, into an above-ground temporary storage tank. This permits cleaning the subterranean storage tank and the screen baffles. After this cleaning, the solution is returned from the temporary tank to the storage tank by the small pump.

On each stripping job, approximately 500 gal. of solution is lost through normal attrition, such as solution left adhering to the locomotive. This necessitates a test tube check of the strength of the remainder of the solution and the addition of sufficient water to bring the mixture up to the 4,000-gal. level.

Advantages claimed for this washing and stripping racks include economy in cost and man-hours and superior results. Preparation of a locomotive for the rack in nowise compares with the elaborate process necessary for hand cleaning. The locomotive is cut loose from its tank and special tin coverings are placed over the headlight, dynamo and sand box to prevent moisture from entering the machinery, this work taking approximately three hours.

Operation of the rack is a one-man job, consisting of proper manipulation of control valves and cleaning the screens. The washing, stripping, and rinsing is completed in a combined time of about two hours, which is a great advantage over the day-long job of hand cleaning and paint removal by lye vat.

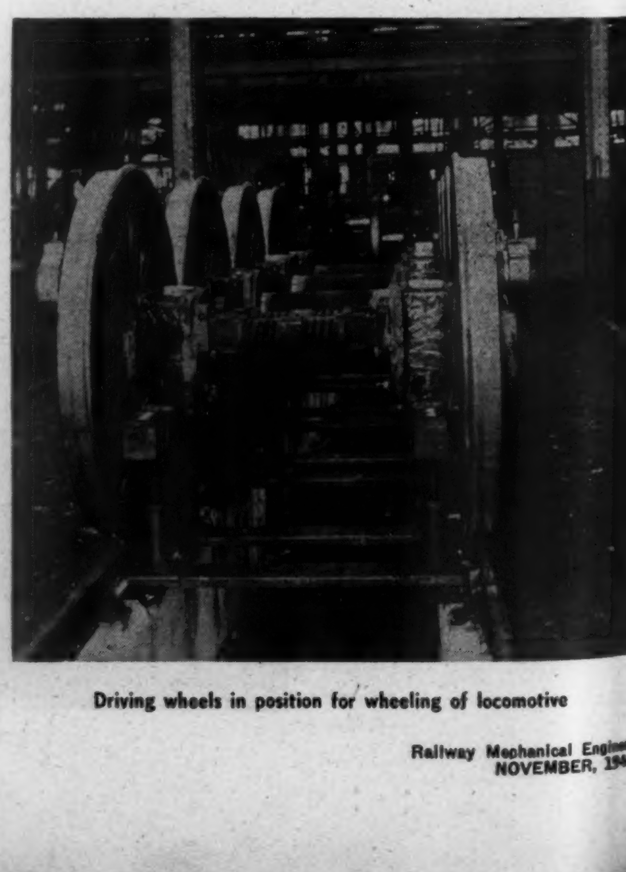
The 4,000 gal. of solution used in the rack ranges in cost from approximately \$100 to \$150, depending on the type of powder used. The 500 gal. additions after each locomotive stripping vary in cost from about \$30 to \$40, again depending upon the type of powder. It should also be pointed out that the solution is reused with some attrition loss, whereas under the old method none of the chemical was saved.

Labor costs are difficult to measure in the overlapping operations connected with locomotive washing. For instance, locomotives are dismantled for repair purposes as well as for grease and paint stripping; also, the rack attendant after starting the chemical spray may do other work elsewhere while a locomotive is being washed.

It has been estimated that the total washing and stripping expenditure for one locomotive, including both cost of materials and labor, under the rack method, is in the neighborhood of \$75, or less than a third of the estimated total cost of \$250 under the old system. In addition, the rack turns out a much cleaner job than is accomplished by the hand method. At the present time, locomotives are passing through the Cheyenne rack at an average of 20 a month. A patent is pending on this automatic locomotive washing and stripping rack.

Wheeling Device

In wheeling locomotives at the Southern's Pegram shops, Atlanta, Ga., the operation is accomplished by the use of a device which permits the wheels with the driving

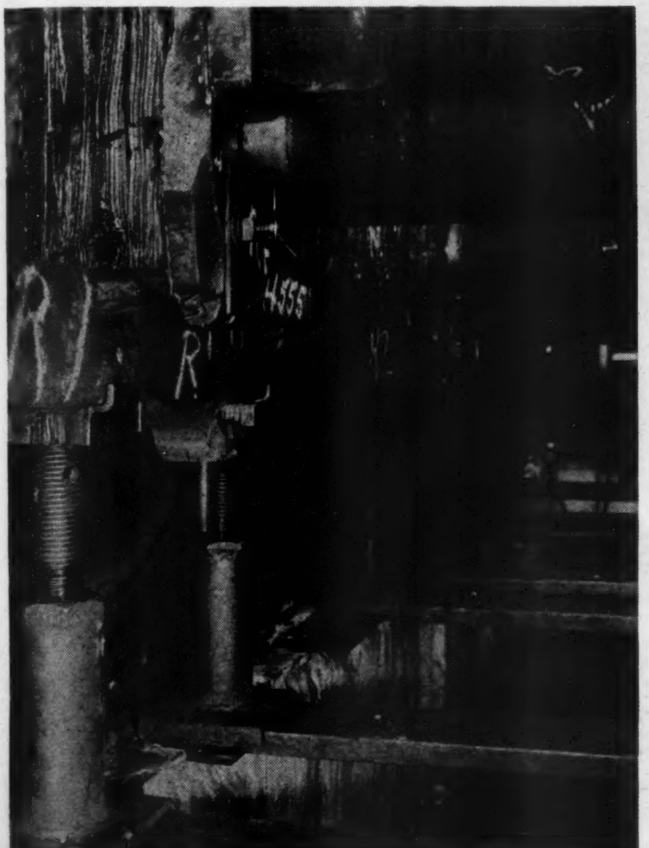


Driving wheels in position for wheeling of locomotive

boxes mounted and with the shoes, wedges and binders in place to be set on the wheeling pit in proper relation to each other. By making these preparations prior to the moving of the locomotive actual wheeling time is reduced, jacking of the binders into position is eliminated, and greater safety is obtained.

Two wheeling devices are used under each pair of wheels as shown in the illustrations. Each consists essentially of two special screw jacks that are supported on a steel plank extending across the pit which, in turn, hold the binders in position under the driving boxes. Each steel plank, 1½ in. by 8 in. by 50 in., rests on steel plates, ⅝ in. by 8 in. by 16 in., inserted beneath the rails on each side of the pit.

The screw jack is made of 4-in. tubing 10 in. long with a 2½-in. nut welded on top. The lower half of



Details of the wheeling device

the nut is turned down to fit inside of the tubing before they are welded together. The base of the jack is a ½-in. U-shaped plate welded to the tubing. It has an inside dimension between the lips of 8¼ in. that allows it to be slid on the steel plank laterally but not longitudinally of the pit.

The jack screw is fitted with a swivel head consisting of a steel block, 1½ in. by 4 in. by 5 in., on top of which a U-shaped plate of ¼-in. steel is welded. This plate is shaped to fit the binders. The jack screw head swivels on a turned-down portion of the screw which extends one inch into a hole in the base of the head.

To guide the binder bolts into the holes in the binders as the locomotive is lowered onto the wheels the holes are countersunk on top. After the binder bolt nuts are put on, the locomotive and wheels are lifted together and blocks are placed on the jacks. Upon lowering the locomotive again the binders are forced up tightly into position on the pedestal legs.

Storage of Cylinder Heads

Storage racks for making a neat arrangement of the main cylinder heads, valve cylinder heads and dome caps from the locomotives undergoing repairs at the Southern's Pegram shops, Atlanta, Ga., are made from scrap flues and a few pieces of scrap iron.

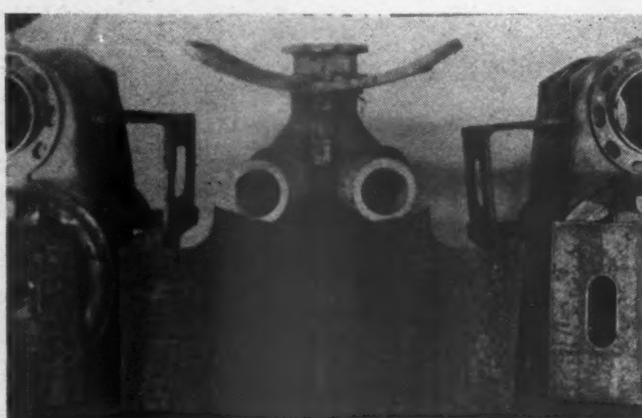
The racks consist of two 5½-in. superheater flues laid

Storage racks for main and valve cylinder heads and dome caps made of scrap superheater flues

parallel, 8½-in. between centers, and welded to U-clamps which act both as standards to support the flues on the ground and as braces to hold them in position. The clamps are of ⅜-in. by 3-in. iron with a 14-in. inside width and with the ends bent upwards 4½ in. Slots in the flues are made every 15 in. for main cylinder heads and every 8 in. for valve cylinder heads and dome caps to form recesses into which the heads and caps are rolled in an upright position. The slots are 1½ in. wide and are cut lower on the inside of each flue than on the outside to fit the curvature of the parts to be stored.

Cylinder Welding Job

The Illinois Central has in the past fabricated one complete set of steam locomotive cylinders in a single unit by welding at the company's main locomotive repair shops,



Old cylinder parts and new plates used in rebuilding

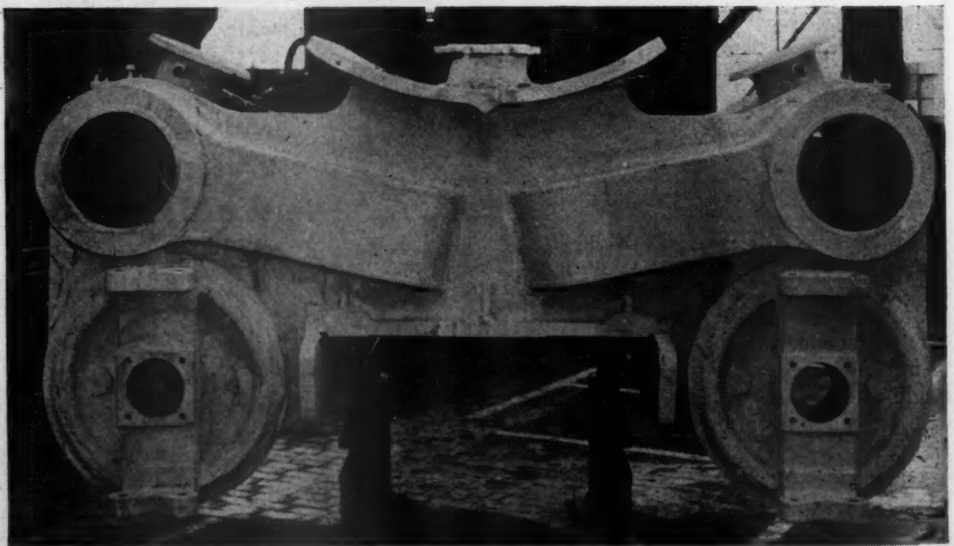
Paducah, Ky. The illustrations show how, in emergency during the war period, a pair of cast-steel steam cylinders which had given trouble due to breakage in service was completely rebuilt by the same process.

These particular cylinders repeatedly cracked in various places and worked loose in spite of numerous attempts to make repairs by welding the cracks and holding the two cylinder castings together by heavy round-steel tie-bars and welding.

The first step in the rebuilding job was to cut out the front and back walls and all of the bottom, leaving only the cylinders, saddle and part of the exhaust ports to be incorporated in the reconstructed cylinder unit. These parts and some of the new plates used are shown in one of the illustrations. This illustration also shows the the cylinders cooled, the cylinder centers were trammed and spaced ⅝ in. more than the specified standard center spacing and the valve-chamber centers were spaced ½ in. more than standard. This slightly smaller allowance was required because of the smaller amount of metal at valve chamber level.

The next operation was welding the bottom plate in place. Then the outside exhaust channels and back cylinder heads were welded on. Reinforcing webs or corner brackets were applied by welding at various points as required. The welding was done by the electric process. About 500 lb. of welding wire was used for the job which took four men 22 days and cost approximately $2,300 for labor and material. Undoubtedly the time and cost of rebuilding this first pair of steam cylinders by welding

How the old cylinders were held together



Completely re-welded cylinders with back cylinder heads also welded in place

inside braces which were first welded in place. Then, by welding the saddle halves at the joint the two cylinders and saddle were made into one unit. Front and back panels were next placed in position and welded.

The cylinders were held square and clamped the correct distance apart by means of a pair of locomotive main rods extending across the two steam cylinders front and back and strapped together. To allow for contraction as were greater than would be required for subsequent units.

On completion of the cylinders, they were normalized by heating to 1,250 deg. F. for 4 hr. in a car-bottom furnace and allowed to cool down with the furnace which took 8 hr. A water test showed no leaks and since being applied to a locomotive in regular service the cylinders have been operated successfully without failure of any kind.

NEW DEVICES

Improved Design of Evans Auto-Railer

Two models of the post-war Auto-Railer, the dual-purpose "on and off the track" railroad vehicle manufactured by Evans Products Company, Detroit, Mich., were shown on September 17 at Chicago. One was a 1½-ton truck equipped with a canopy body adaptable for equipment with necessary tools for a light freight-car wrecking truck, among other uses. The second model was a de luxe official inspection car designed to provide the comfort and visibility of a station wagon.

Auto-Railer vehicles are equipped with retractable flanged steel pilot wheels which serve as guides when the vehicles are in operation on railroad tracks. For highway operation the pilot wheels are retracted by an hydraulic mechanism operated by controls located near the steering wheel.

The rubber tires used on the Auto-Railer were especially designed to provide maximum traction on both dry and wet or slippery rails. The coefficient of friction of these tires on the rails is about three and one-half times that of conventional steel railroad wheels on rails. During rail operation about 50 per cent of the vehicle load is carried by the rubber tires. All driving and braking is through these tires; the flanged steel pilot wheels serve only as guides.

These vehicles, first brought out by Evans over ten years ago, incorporate a variety of improvements as a result of war-gained experience. These include reduction in over-all weight, simplified hydraulic retraction mechanism, improved weight distribution, stabilizer springs for rail operation and safety lights in the driver's compartment to indicate the position of the pilot wheels at all times. An optional reverse gear providing equal speeds forward or reverse has been incorporated for use during rail operation.

The 1½-ton Auto-Railer chassis can be adapted to a variety of railroad uses by the installation of such equipment as cranes and power shovels, dump truck bodies, blade plows, pressure grouters, air compressors, generators and welders. A special chassis is required for this equipment. To gain quantity production costs it was necessary to standardize on one particular make. This special chassis is manufactured solely for Evans. The Auto-Railer vehicles are designed for speeds up to 60 m.p.h. on both railroad track and highway. They can be placed on the track in 30 sec. and run off the track without a stop at any road crossing.

Evans Auto-Railer adaptable for car department and other uses

Single-Point Slack Adjuster

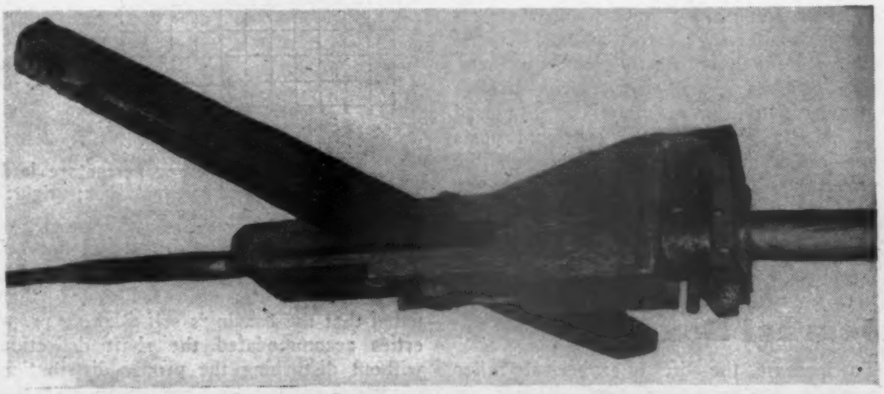
The Adjuster Corporation, Chicago, has recently developed and placed on the market a single-point slack adjuster designed to afford a simple and effective means of taking up slack in foundation brake rigging as a result of shoe wear or other cause without the necessity of making the usual adjustment at multiple-hole fulcrums attached to individual truck bolsters and the brake cylinder pressure head or car body.

The device consists, as shown in the illustration, of a cast-steel body with U-shape interior sliding portion positioned by an adjusting nut having a 1⅛-in. Acme thread and a single locking plate to hold the nut positively against turning except when necessary adjustments are made.

The adjuster is pin-connected to the floating lever, and the rod at the right end is connected in the usual manner to the cylinder lever. With this slack adjuster in place, it is possible manually to maintain proper piston travel at this one point alone, adjusting the slack evenly between both ends of the car and maintaining proper angularity of the levers throughout the entire range of brake-shoe wear.

The operation is simple. By turning the adjusting nut of the device, the distance between the two brake-cylinder levers is either reduced or lengthened as the case may be, and this, due to the fact that the fulcrum points of the levers have not been disturbed, takes up the slack evenly on both ends of the car.

This slack adjuster makes it unnecessary to have more than one hole in each fulcrum and brake-rod and lever connection throughout the car; also it is not necessary to remove a cotter and lever pin in order to take up slack as is now the case. The only requirement is to release the locking feature and turn the adjusting nut in the required direction. This can be done without any tools.



Slack adjuster designed to give simple and effective manual control of brake gear slack

Train-Control Governor for Diesels

A governor, arranged for application to anti-friction bearing bearing boxes of railway trains, has been announced by the Union Switch and Signal Company, Swissvale, Pa. It is designed for use with automatic train control equipment and provides means for the enforcement of fixed speed limits in accordance with signal indications determined by track conditions in advance. It is arranged for operation

with two-speed limits ranging from 20 to 100 miles per hour.

Two sets of independent double-break contacts are provided for each speed limit. These contacts are employed in the circuit which controls the application and release of the train brakes. When the predetermined speed limit is exceeded, the contacts open and initiate an automatic-brake application. When the speed is reduced to the fixed speed limit, the governor contacts close and this permits the engineer to release the train brakes.

The governor is of the direct-acting centrifugal type and is composed of three principal elements: (1) a body and bottom plate assembly which is bolted to the journal box either directly or by means of an adapter; (2) a centrifuge rotor mounted on ball bearings in the body and driven from the end of the axle, and (3) a contact assembly carrying contacts operated directly by the centrifuge.

The centrifuge rotor is composed of a single pair of centrifuge weights balanced against the forces of vibration and gravity, which operate a low-speed spring and a high-speed spring. As the speed of rotation increases, the centrifugal force moves the centrifuge weights outwardly against the effort of these springs and resultant motion is transmitted directly to the contacts. The characteristics of the centrifuge weights and springs give quick contact opening and the simple construc-

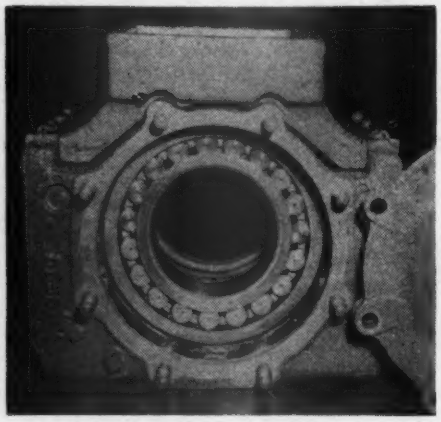
Installation of two-speed train-control governor on a Diesel truck

tion used results in few wearing parts and a compact arrangement.

The contact compartment cover is fastened by four self-locking nuts and, when removed, makes the contact assembly accessible for inspection, testing or adjustment. The contacts are of rugged construction made of high-grade material. Standard A. A. R. Signal Section terminal posts and insulation clearances are provided. The governor regularly has a plug connector and hose-type conduit for carrying the wires between the car body and the governor.

Journal Box

To increase the life of spherical roller bearings on passenger cars, electric or Diesel-electric locomotives, and on steam locomotive tenders or trailers, a journal box has been designed by SKF Industries, Inc., Front street and Erie avenue, Philadelphia 34, Pa., to eliminate the usual concentration of forces at the top center. A



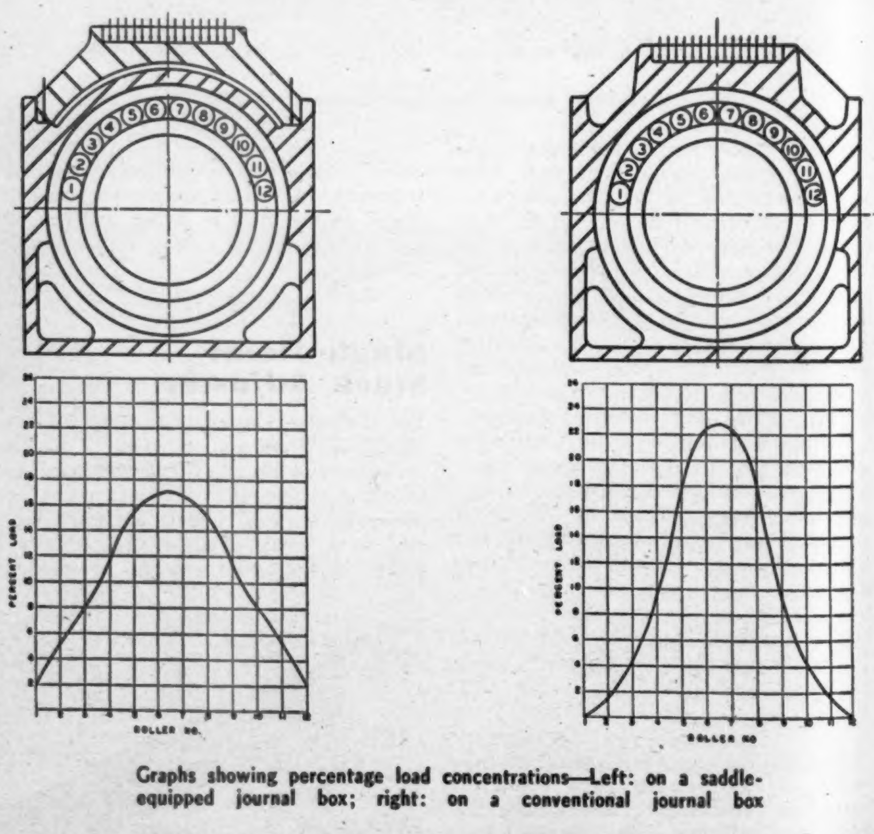
SKF saddle-equipped journal box

steel arch or saddle fits in a machined recess in the top of the box. This applies the load at the sides in equitable distribution.

A series of studies by SKF led to the overall design of this journal box. The decision to use a two-bearing mounting was the result of a previous analysis which showed that such mounting utilized more of the effective length of the journal, recognized that the journal box itself is subject to elastic deformations which, unless properly provided for, will result in load concentrations harmful to bearing life.

To combat the concentration of load, the steel arch was devised and incorporated in the design of the bearing to avoid the deformation of the top half of the box that results from service loads. This deformation, in turn, caused the load to be carried on the top 20 per cent of the roller complement; thus, as the rolling elements rotated about the inner ring, the load was carried only for a small portion of the time on the few rollers directly on top. Since the life of an anti-friction bearing is approximately inversely proportional to the cubic mean of the loads on the rollers, any reduction in the maximum roller load through a more uniform distribution should result in an increase in bearing life. With the top section relatively flexible, the maximum load was said to be reduced by about 25 per cent. Endurance tests conducted with the saddle-type box indicated an increase of approximately 33 per cent in bearing life. Strain-gage measurements showed that the stress in the box did not exceed 6,000 lb. per sq. in. under normal service conditions.

As the saddle is a separate piece, it can be varied to fit a wide range of spring rigging arrangements, thereby reducing the inventory of spare wheel and axle assemblies which railroads must maintain. With-



Graphs showing percentage load concentrations—Left: on a saddle-equipped journal box; right: on a conventional journal box

weighed less per journal and did not require as large an outside diameter as the single-bearing housing. It was further noted that the bearing's self-aligning properties accommodated the shaft deflection without disturbing the proper distribution of the load between the races and the rollers. At the same time, however, it was out disturbing the bearings or the housing it can be used interchangeably on four- or six-wheel trucks with coil springs, single or double equalizer suspensions. Wheel-slip devices, train-control speedometer drives, speed governors, and electrical or chemical hot box alarms can be applied without any changes in design.

NEWS

Goodwin Mechanical Engineer, Transportation Corps

GEORGE S. GOODWIN, for the past three years with the railway supply division of the Reynolds Metal Company at Chicago, has been appointed mechanical engineer, Army Service Forces, Transportation Corps, Rail Section of the United States Army. Before joining Reynolds Metal, Mr. Goodwin was in the mechanical department of the Chicago, Rock Island & Pacific, where he served successively as chief draftsman, mechanical engineer and assistant to the general superintendent of motive power.

C. & O. Authorizes $834,000 for Machinery

THE Chesapeake & Ohio has authorized the expenditure of $834,000 for additional machinery installations in its car shops at Russell, Ky., R. J. Bowman, president, has announced. The machinery, for fabricating the steel to be used in repairing approximately 3,000 cars annually, will consist of shears, punching machines, forging machines, furnace, presses, lift trucks, and related machinery.

The operation will provide employment for approximately 50 additional men, the announcement said, adding it probably will take the better part of a year to obtain delivery of the various items and to get the facilities in operating condition.

Army Seeking Mechanical Engineers and Draftsmen

THE Rail Branch of the Transportation Corps Board, New York Port of Embarkation, Brooklyn, N. Y., needs qualified mechanical engineers and mechanical draftsmen who have experience in performing research work on all types of railroad rolling stock involving specific experience in railroad engineering; including the designing of steam locomotives, internal combustion locomotives, or passenger and freight cars. The salaries of these Civil Service positions range from $4,000 to $8,000 per annum for mechanical engineers, and from $3,000 to $5,000 per annum for mechanical draftsmen. For more detailed information regarding these positions, write to the Civilian Personnel Branch, Recruitment and Placement Section, New York Port of Embarkation, First avenue and Fifty-eighth street, Brooklyn, N. Y.

National Metal Exposition

THE American Society for Metals, the American Welding Society and the Iron and Steel division and the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers will participate in the Twenty-eighth National Metal Exposition to be held in the municipal auditorium, Atlantic City, N. J., from November 18 to November 22, inclusive. The American Industrial Radium and X-Ray Society also will participate in the exposition from November 19 to November 22.

Advance programs of the participating societies reveal that unusual interest is being displayed by the authors of technical papers, it was announced. The program committee of the American Society for Metals has reported that more than twice the normal number of papers have been submitted by members for consideration and possible presentation before the society's session during the exposition. Exhibit space will be utilized to show advances in production and manufacturing techniques developed during the past five years.

A. S. M. E. Annual Meeting

"THE Public Responsibility of the Engineer" is to be the theme of the 1946 annual meeting of the American Society of Mechanical Engineers to be held at the Hotel Pennsylvania, New York, December 2-6. At the banquet on Wednesday evening, December 4, certificates of honorary membership will be presented to L. K. Sillcox, first vice-president, New York Air Brake Company, and to A. G. Christie, professor mechanical engineering, Johns Hopkins University. Animated pictures describing engineering techniques are among the industrial films to be shown. The tentative program, in part, is as follows:

MONDAY, DECEMBER 2

Morning

Rubber and Plastics (I)

Vibration Dampening with Rubber Mountings, by Robert Lewis, M-B Manufacturing Company, Inc., New Haven, Conn.

Laboratory Testing of Rubber Torsion Springs, by D. H. Cornell and J. R. Beatty, B. F. Goodrich Company, Akron, Ohio.

TUESDAY, DECEMBER 3

Morning

Power (II)—Fuels (II)

Wartime Lessons in Coal Burning, by C. E. Miller, principal mechanical engineer, War Department, Office of Chief Engineers, Washington, D. C.

Pulverized Coal for the Gas Turbine, by Martin Frisch, chief engineer, Foster Wheeler Company, New York.

Future Trends in the Application of Coal-Burning Equipment, by F. W. Argue, power engineer, Stone & Webster Engineering Corporation, Boston, Mass.

WEDNESDAY, DECEMBER 4

Morning

Oil and Gas Power (I) — Power (IV)

Gas Turbines:

Part-Load Characteristics of Marine Gas-Turbine Plants, by W. M. Rohsenow, assistant professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass., and J. P. Hunsaker, consulting engineer, Jackson & Moreland, Boston, Mass.

Some Effects of Pressure Loss on Open-Cycle Gas Turbines, by J. I. Yellott, director of research, Locomotive Development Committee, Baltimore, Md., and Eric F. Lype, instructor and section supervisor, Illinois Institute of Technology and Institute of Gas Technology, Chicago.

Fuels (III)

The National Fuel Reserves and Their Relation to the Future Supply of Liquid Fuel, by A. C. Fieldner, Bureau of Mines, Washington, D. C.

Factors Rarely Considered in Smoke Abatement, by H. F. Hebley, Pittsburgh Coal Company, Pittsburgh, Pa.

Afternoon

Railroad (I)

Symposium—Diesel Locomotive Design for Reduced Maintenance:

Keynote speaker and presiding officer J. P. Morris, general assistant (mechanical), Atchison, Topeka & Santa Fe.

Prepared discussions:

Diesel Prime Movers, by H. H. Urbach, mechanical assistant to vice-president, Chicago, Burlington & Quincy.

Electrical Equipment, by W. C. Marshall, assistant superintendent motive power (Diesel operation), Chicago, Milwaukee, St. Paul & Pacific.

Chassis and Running Gear, by G. F. Wiles, supervisor Diesel-electric locomotive operation, Baltimore & Ohio.

Accessories, by F. Thomas, assistant to general superintendent motive power, New York Central System.

Oil and Gas Power (I) — Power (IV)

Gas Turbines:

The Value of Wet Compression in Gas-Turbine Cycles, by R. V. Kleinschmidt, Stoneham, Mass.

Gas Turbines with Water Injection, by C. A. Norman, professor, Ohio State University, Columbus, Ohio, and R. H. Zimmerman.

THURSDAY, DECEMBER 5

Morning

Oil and Gas Power (III) — Power (VI)

Gas Turbines:

Recent Gas-Turbine Developments, by Dr. Adolphe Meyer, Brown-Boveri Company, Baden, Switzerland.

A 2,000-Hp. Gas-Turbine Generator Set, by T. J. Butz, gas-turbine engineer, Westinghouse Electric Corporation, South Philadelphia, Pa.

Railroad (II)

Annual Report on Progress in Railway Mechanical Engineering and Symposium on Weight Savings in Passenger-Car Specialties:

Keynote speaker and presiding officer, P. W. Kiefer, chief engineer motive power and rolling stock, New York Central System.

Prepared discussions (Eleven 10-min. papers from supply companies in the railroad field).

Fuels (IV)

Progress Report on Pressurized Combustion of Pulverized Coal: Coal preparation; fly-ash removal, and introduction to combustion, by J. I. Yellott, director of research, Locomotive Development Committee, Baltimore, Md.

NOON

Railroad luncheon

Afternoon

Railroad (III)

Continuation of passenger-car symposium

FRIDAY, DECEMBER 6

Afternoon

Applied Mechanics (VIII)

Gas Turbine Seminar Session:

Stress Consideration, by W. B. Goddard, N. C. Price, C. C. Davenport, and R. G. Allen.

Gas-Turbine Materials

Precipitation Hardened Alloys for Gas-Turbine Service, by Howard Scott and R. B. Gordon, Westinghouse Electric Corporation, South Philadelphia, Pa.

Materials for Power Gas-Turbines, by C. T. Evans, Jr., The Elliott Company, Jeannette, Pa.

Nickel-Chromium Alloys for Gas Turbines, by C. A. Crawford, development and research department, International Nickel Company, N. Y.

Union Asks Installation of Steel Pilots with Retractive Couplers

CONTENDING that devices now in use on a large number of locomotives "lack sufficient strength" and are "deficient in design," the Brotherhood of Locomotive Firemen and Enginemen has filed a petition with the Interstate Commerce Commission in which it has asked the commission to issue an order requiring the railroads to install "substantial" cast-steel pilots with retractive couplers on all locomotives operated in road service.

According to the union's president, D. B.

Robertson, who filed the petition, such an order would help cut down the toll of "life and limb" and property damage, particularly in grade-crossing accidents. He stated that obstacles struck at grade crossings or elsewhere "frequently are not thrust from the path of the engine and train" but become wedged under the engine trucks and wheels, thereby resulting in derailments.

The petition also noted that when locomotives are equipped with "substantial pilots with retractive couplers," accidents to persons on the locomotive and train and to the train itself are "mitigated or prevented."

Aluminum Refrigerator Car Developments

ALUMINUM refrigerator car No. 51,000, built to customer specifications at the Illinois Central car shops, McComb, Miss., was recently christened in ceremonies attended by shipping and transportation representatives from many parts of the country.

The car is the Illinois Central's answer to the request of the Refrigerator Car Committee of the United Fresh Fruit & Vegetable Association for a lightweight, all-purpose, low-temperature, easy-riding, ice-cooled car. The committee, headed by J. N. Kelley, manager of fruit transportation, Fruit Dispatch Company, is comprised of officers of shipping associations and consignees from California to Maine, Florida to Washington.

An experimental lightweight refrigerator car which has been under construction for almost a year in Los Angeles, Calif., has just been completed by the Pacific Fruit Express Company and is to go into actual service, undergoing extensive car tests and research during the next two years. Exterior sheathing of the many-purpose, standard-dimension car is Reynolds aluminum alloy. Virtually all improvements suggested by the National Fruit and Vegetable Trade Committee are embodied in this car, according to P. F. E.

Refrigerator Cars in Cross-Country Experiment

SIX refrigerator cars of new design, each loaded with frozen foods, have recently been under the careful scrutiny of a corps of research engineers in connection with a series of tests which railroad and government representatives are making in order to determine what further improvements can be made in the present method of insulating such cars so that the best types of equipment for general service can be provided.

The cars, built by the American Refrigerator Transit Company, St. Louis, Mo., contain various amounts of insulation ranging from 3 to 7 in. in thickness. Two of the cars have reflective insulating material. The cars were loaded with frozen foods at Hillsboro, Ore., on October 2 and then were moved to Cincinnati, Ohio, the route being Southern Pacific, Union Pacific, Chicago & North Western, Indiana Harbor Belt and Pennsylvania.

In building these refrigerator cars, thermo-couples were placed in the walls, floor and ceiling, from the exterior of each car to the interior at strategic points so that the transmission of heat might be recorded from origin to destination. The K values (heat-transmission flow) of the insulation used are to be determined through the hot-plate method and will serve as a heat-flow meter, which, together with the temperatures recorded on the test trip, will make it possible accurately to compute the transmission of heat through the car superstructures.

As a balance against these computations, an accurate measurement of the refrigeration input into each car will be determined through careful weights of ice and salt used. This information, together with the specific heats of structural materials in the car, as well as the loading, will give a check against the heat-flow computations.

A Brown electronic precision-indicating pyrometer, together with a key switch cabinet with 120 switch points was installed in

Orders and Inquiries for New Equipment Placed Since the Closing of the October Issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
Chicago, Burlington & Quincy	6[1]	6,000-hp. Diesel-elec. frt.	Electro-Motive
	2[1]	4,500-hp. Diesel-elec. frt.	Electro-Motive
	3[1]	4,500-hp. Diesel-elec. pass.	Electro-Motive
	5[1]	4,000-hp. Diesel-elec. pass.	Electro-Motive
	1[1]	2,000-hp. Diesel-elec. pass.	Electro-Motive
Chicago, Indianapolis & Louisville	1	1,500-hp. road-type Diesel-elec. switch.	American Loco.
	1	1,000-hp. Diesel-elec. switch.	Fairbanks-Morse
Clinchfield	4	4-6-6-4	American Loco.
Grafton & Upton	2[2]	Diesel-elec.	American-G. E.
Laurinburg & Southern	1	Diesel-elec.	American-G. E.
Missouri-Kansas-Texas	5[3]	1,000-hp. switch.	Baldwin Loco. Wks.
	5[3]	1,000-hp. switch.	Electro-Motive
Seaboard Air Line	13	3,000-hp. single-unit Diesel-elec.	Baldwin Loco. Wks.
Springfield Suburban	2[4]	Diesel-elec.	American-G. E.
Texas & Pacific	7	1,000-hp. Diesel-elec. switch.	Electro-Motive

Freight Car Orders

Road	No. of cars	Type of car	
Atchison, Topeka & Santa Fe	750[5]	50-ton box	General-American
Atlanta & West Point	50	50-ton box	Pullman-Standard
Baltimore & Ohio	1,000	50-ton hopper	Bethlehem Steel
	500	70-ton hopper	Pressed Steel Car
	500	70-ton hopper	Pullman-Standard
Central of Pennsylvania	8[6]	70-ton covered hopper	Harlan & Hollingsworth
Chicago, Burlington & Quincy	1,000[7]	Hopper	Company shops
	800[7]	Box	Company shops
	200[7]	Stock	Company shops
	100[7]	Parts cars	Company shops
	100[7]	Flat	Company shops
Detroit & Toledo Shore Line	50	70-ton hopper	Greenville Steel Car
Georgia	50	50-ton box	Pullman-Standard
Gulf, Mobile & Ohio	420	50-ton box	American Car & Fdry.
	80	Auto	American Car & Fdry.
Kansas City Southern	100	70-ton pulp-wood	American Car & Fdry.
Lehigh & Hudson River	20	70-ton covered hopper	Harlan & Hollingsworth
Lehigh Valley	500	50-ton box	Pullman-Standard
	100	70-ton gondolas	Bethlehem Steel
Pennsylvania	1,100[8]	Box	Company shops
Northern Refrigerator Line	50	70-ton refrigerator	Despatch Shops
Southern Pacific	1,000	50-ton box	Pullman-Standard
Union Pacific	1,000	70-ton ballast	American Car
Western of Alabama	50	50-ton box	Pullman-Standard
Western Pacific	250	40-ton box	Mt. Vernon

Freight Car Inquiries

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	250	50-ton box	
Chicago, Indianapolis & Louisville	25	40-ton stock	
	100	70-ton flat	
	100	70-ton gondola	
	100	70-ton hopper	
	200	50-ton box	
Louisville & Nashville	300	50-ton flat	
Missouri Pacific	18[9]	70-ton container	
Union Pacific	1,000	70-ton ballast	

Passenger Car Orders

Road	No. of cars	Type of car	Builder
Illinois Terminal	3[10]	Baggage-coach	St. Louis Car
	2[10]	Coaches	St. Louis Car
	3[10]	Parlor-dining	St. Louis Car

Passenger Car Inquiries

Road	No. of cars	Type of car	Builder
Chesapeake & Ohio	112	Sleeping	
	135	Passenger	
New York, New Haven & Hartford	27	Sleeping	

[1] Approximate cost $8,000,000.
[2] In service.
[3] Approximate cost $1,000,000.
[4] Delivered.
[5] Delivery scheduled for second half of 1947.
[6] To cost $45,600. To be completed in March, 1947.
[7] Approximate cost of equipment $7,500,000.
[8] One hundred cars will be 60½ ft. long; the remaining, 50½ ft. long.
[9] For operation on the Missouri Illinois.
[10] Streamline, aluminum construction.

NOTE:—The MISSOURI PACIFIC has been authorized by the federal district court at St. Louis, Mo., to spend more than $12,000,000 for new equipment and additional facilities. The expenditures, according to P. J. Neff, president and chief executive officer, will include the purchase of 2,200 new freight cars, costing $10,495,000, and the purchase of eight new streamline passenger cars and an additional Diesel-electric locomotive, amounting to $1,300,000.

The *New York, New Haven & Hartford* has requested court authority to spend approximately $6,500,000 for the purchase of 15 additional Diesel-electric locomotives for use in freight service. The locomotives will be of the three-unit type, each unit powered by a 1,500-hp. V-type Diesel engine and capable of operation either in 4,500-hp. triple units, 3,000-hp. double units or 1,500-hp. single units. Conventional air brakes will be supplemented in the new engines by dynamic brakes whereby on descending grades traction motors are turned into generators to control the speed of the train.

a business car operated adjacent to the six cars, and connected by cables to them.

The use of this refrigerator car test equipment during the cooling-off period after cars are iced, during the loading period at Hillsboro, and during the trip from Hillsboro to Cincinnati, will give the investigators a basis on which to evaluate the different types and thicknesses of insulation used.

Lighting Institute at Nela Park Rededicated

The General Electric Lighting Institute, Nela Park, Cleveland, Ohio, which was formally dedicated in a ceremony on September 11, has been completely remodeled and re-equipped. Various rooms are fitted with the best types of lighting equipment available for such specific applications as industrial lighting, office lighting, home lighting, schoolroom lighting, store lighting, etc., each room having different types of fixtures which can be demonstrated separately or together or can be moved about on trolleys to show the effect of change of position. Elaborate mechanical devices are used for quickly changing from one type of lighting to another.

Other rooms are arranged to show the effects, respectively, of quality, quantity and color of light. Artificial sunlight is created on a sun deck. There are also elaborate exhibits of light sources and a large auditorium for lectures and demonstrations.

To those who wish to study lighting, the institute, which has been conducting schools on lighting since 1921, offers one-week and two-week courses covering various phases of lighting application. A two-week course is the equivalent of a full semester of a three-hour class as given by a college or university.

H. G. Hill Promoted to Rank of Colonel

Lieutenant Colonel Howard G. Hill, formerly mechanical engineer of the Southern Pacific, has been promoted to the rank of colonel in the Corps of Engineers—reserve, the War Department has announced. Colonel Hill, who served as general manager of the United States Military Railway in southern Sicily in 1943, is now in Japan conducting a survey of the Imperial Japanese Government Railway for American general headquarters, after which he will return to Washington, D. C., to resume his practice as consulting engineer on railways.

Supply Trade Notes

Lewis Bolt & Nut Co. — *Willard G. Hartman* has been elected president, general manager and director of the Lewis Bolt & Nut Co., at Minneapolis, Minn.

◆

H. K. Porter Company.—C. R. Dobson, formerly chief industrial engineer of the Jones & Laughlin Steel Corp., has been elected vice-president in charge of operation for the H. K. Porter Company. Mr. Dobson will supervise operations of the company's seven manufacturing plants.

C. R. Dobson

◆

Kropp Forge Company. *John V. Haugh* has been appointed engineering representative, with headquarters in Chicago, for the Kropp Forge Company, covering a group of mid-western railroads. Mr. Haugh for the past eight years has operated his own railroad supply business, known as the Haugh Railroad & Industrial Supply Co.

◆

Timken Roller Bearing Company. — The Timken Roller Bearing Company has announced the following appointments in its steel and tube division: *H. R. McLaren,* formerly superintendent of tube mills, has been appointed assistant general superintendent; *J. P. Wargo,* formerly assistant superintendent of tube mills and finishing departments, has been appointed superintendent of tube mills, and *R. R. Elsasser,* formerly manager of the Newton Falls, Ohio, plant, has been appointed assistant superintendent of tube mills.

◆

United States Steel Supply Company. *Wesley N. Gordon* has been appointed manager of the alloy sales division in the general sales department of the United States Steel Supply Company, with headquarters in Chicago.

◆

Morton Manufacturing Company. — *John D. Cannon,* vice-president and treasurer of the Morton Manufacturing Company, Chicago, has been elected president, succeeding *Charles D. Morton,* who retains his position as chairman of the board of directors. *James A. King,* vice-president, has been placed in charge of all railway division sales. *Chester T. Sansfield* has been appointed eastern sales manager, succeeding William M. Wampler, deceased. *Walter M. Klopsch* has been appointed chief engineer. Mr. Klopsch is also president of the Ellcon Company and the National Brake Company, as noted elsewhere in these columns. *John D. Cannon,* the newly elected president of the Morton Manufacturing Company, was born in Chicago, and is a graduate of the University of Illinois. He has been associated with the company since 1929, and has been a vice-president and its treasurer since 1934. *James A. King,* vice-president, to be in charge of all railway division sales, joined the Morton Company in 1919, and was elected a vice-president in 1934. He has been in charge of engineering for many years.

John D. Cannon

James A. King

◆

American Lumber & Treating Company.—*T. J. Flynn,* assistant to the Southeastern district sales manager of the American Lumber & Treating Company, with headquarters at Jacksonvill, Fla., has returned to that position following his release from military service. *William E. Wilkins,* who prior to his call to active military duty in 1941, was assistant to the sales

manager at Boston, Mass., has returned to the company as a member of its New York sales staff. *William A. McFarland,* chemical research engineer for the American Lumber & Treating Co., has been placed in charge of a new laboratory at Wauna, Ore.

◆

FAIRBANKS, MORSE & CO. — *James G. Graham* has been appointed district manager of the Railroad division of Fairbanks, Morse & Co., with headquarters at Chicago.

James G. Graham was educated at Ohio

James G. Graham

State University and Drexel Institute. He then joined the J. G. Brill Company at Pittsburgh, Pa. In 1928 he obtained a position in the operating department of the Baltimore & Ohio. In 1932 he became general agent in the freight department of the New York Central and in 1938 general manager of railroad sales of the Oliver Iron & Steel Corp. at Pittsburgh.

◆

HEVI-DUTY ELECTRIC COMPANY.—*Arthur W. Frank,* district manager of the Hevi-Duty Electric Company, at Chicago, has been appointed director of research, with headquarters at Milwaukee, Wis. Mr. Frank is succeeded by *Lawrence S. Tilden,* assistant district manager.

◆

SKILSAW, INC.—*Skilsaw, Inc.,* manufacturer of portable electric tools at Chicago, has purchased the Forss Pneumatic Tool Company of Aurora, Ill.

◆

CLARK EQUIPMENT COMPANY.—*Russell F. Oakes,* formerly chief, Office of Technical Information, Office of the Chief of Transportation, United States Army, has been appointed executive assistant to the vice-president of the Clark Equipment Company and general manager of the Clark Tructractor division.

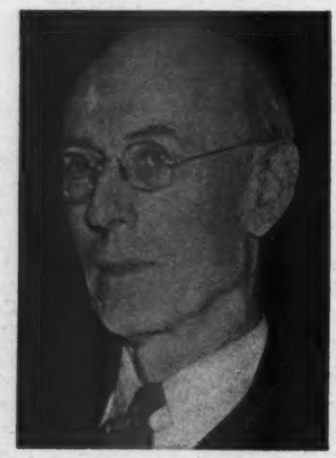
◆

JOHNS-MANVILLE CORPORATION.—*R. W. Lea,* vice-president of finance since 1939 for the Johns-Manville Corporation, has been elected president to succeed *Lewis H. Brown,* who was elected chairman of the board and chief executive officer. *Alvin Brown* was elected a director and vice-president for finance and *John P. Syme* was elected vice-president and assistant to the chairman.

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY. — The Minneapolis-Honeywell Regulator Company has announced the following changes in its field and home office personnel: *James S. Locke,* formerly regional sales manager of the Chicago district of the air-conditioning controls division, has been appointed sales manager for the division, with headquarters in Minneapolis, Minn., to succeed *George D. Guler,* who has been appointed regional manager, with headquarters in Atlanta, Ga. Mr. Guler succeeds *Albert H. Koch,* who has been appointed branch manager at Philadelphia, Pa. *J. F. Cummiskey* has been appointed Chicago regional sales manager of the air-conditioning controls division, replacing Mr. Locke. *L. C. Johnson* has been promoted to branch manager in Milwaukee, Wis., to succeed *Harold Pride,* resigned, and *J. C. Dorsey,* acting branch manager in Philadelphia, has been placed in charge of the company's business in Philadelphia. *T. S. Carley* has been promoted to sales manager of the wholesale division, Minneapolis, and will continue as sales manager of the stoker controls division.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Sherman Miller,* formerly chief mechanical engineer, has been appointed vice-president in charge of production engineering for the American Locomotive Company, with headquarters as before at Schenectady, N. Y. *Raymond J. Finch* has been appointed chief



Sherman Miller

mechanical engineer at Schenectady, to succeed Mr. Miller.

Sherman Miller began his career with American Locomotive in the erecting shop and drawing room of the Dunkirk, N. Y., plant. He was transferred to Schenectady in 1907 and served as general superintendent of the general drawing room from 1916 to 1941, when he was appointed chief mechanical engineer.

◆

FAFNIR BEARING COMPANY. — *Fayette Leister* has been elected vice-president in charge of engineering for the Fafnir Bearing Company, New Britain, Conn. Mr. Leister joined Fafnir in 1921 as a sales engineer. He was placed in charge of the company's branch office in Detroit, Mich., in 1935, and in 1945 was appointed engineering manager of the main plant in New Britain.

NATIONAL MALLEABLE & STEEL CASTINGS CO.—*Cleve H. Pomeroy,* former vice-president and secretary-treasurer of the National Malleable & Steel Castings Co., has been elected president, to succeed *Charles H. McCrea,* whose death was reported in the September issue.

Cleve H. Pomeroy is a graduate of Adel-

Cleve H. Pomeroy

bert College of Western Reserve University (1912). He joined National Malleable in 1920, and has served successively as credit manager, assistant treasurer, treasurer, secretary and treasurer and vice-president in charge of finances and accounting. Mr. Pomeroy, who has been a member of the board of directors since 1938, will continue also as treasurer of the company.

◆

JOSEPH SINKLER, INC.—*Richard J. Shanahan* has been appointed midwestern representative of Joseph Sinkler, Inc., at Chicago. Mr. Shanahan began work in railroad sales in 1929, with the Boss Bolt & Nut Co., and a year later joined the sales staff of the Maintenance Equipment Company. In 1940 he became associated with

Richard J. Shanahan

the Gustin Bacon Manufacturing Company, and in 1944 became sales manager of the U. S. Wind Engine and Pump Company. In 1944 he went into business for himself.

◆

CARBONE CORPORATION. — The Carbone Corporation, Boonton, N. J., manufacturer

of carbon brushes, dry cells and signaling batteries, has announced the transfer of *E. C. Brehm* to be district manager of the Pacific Coast territory, with offices at 116 New Montgomery street, San Francisco, Calif. Mr. Brehm will supervise all sales and service in the Pacific Coast territory. *R. B. Lamkin*, formerly with the signal department of the Pennsylvania, succeeds Mr. Brehm as district manager of the Chicago office, 53 West Jackson boulevard.

◆

LINCOLN ELECTRIC COMPANY. — *C. M. Taylor* has been elected executive vice-president of the Lincoln Electric Company. *C. M. Taylor* has been with Lincoln since 1916. He enlisted in the air corps in 1917 and at the end of the war was appointed a

C. M. Taylor

foreman. Later he was placed in charge of the time study and methods department, advanced to assistant superintendent and then superintendent. He was appointed vice-president in charge of sales in 1928. Since 1927 he has served on the board of directors.

◆

ELECTRO-MOTIVE DIVISION, GENERAL MOTORS CORPORATION.—The Electro-Motive division of the General Motors Corporation is constructing locomotive repair shops, at Jacksonville, Fla., and Baltimore, Md. Two other shops are already established—one at Emeryville, Calif., and another at the main plant at La Grange, Ill. This chain of shops, the division states, will afford the railroads the use of original factory machinery and methods, and economies of quality production.

C. R. Wood and *LeRoy F. Shaw* have been appointed branch parts managers of the shops being built at Jacksonville and Baltimore. Other personnel changes in the Electro-Motive division are: *Milton H. Gardner*, regional service manager at Chicago, who has been transferred to the firm's new regional field service organization at St. Louis, and *M. L. Williams*, who has been appointed parts and stores representative there. Mr. Gardner will be assisted by *J. E. O'Leary*, formerly field engineer of the central region, *Earl Stroud*, district engineer at St. Louis, and *A. M. Dodd*, who has been transferred from Cincinnati, Ohio. *R. H. Beight* has been appointed district engineer at Fort Worth, Tex., where representation has been recently restored.

Mariano A. Montero has been appointed district engineer of a newly created district to serve Mexican railroads, with headquarters at San Luis Potosi, Mex. He will be assisted by *Fred M. Smith*, service engineer, formerly of the La Grange plant. *Gerald C. Smith* has been appointed district engineer of the Denver service headquarters, now under the jurisdiction of the St. Louis region, succeeding *W. E. Dunn*, who has been appointed regional service manager of the Chicago region.

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E. I. DU PONT DE NEMOURS & CO.—*Frank P. Smith* has been appointed sales engineer in the Cleveland, Ohio, region for E. I. du Pont de Nemours & Co. Mr. Smith, whose headquarters will be in Pittsburgh, Pa., will serve the clientele formerly served by W. J. Bradley for the Du Pont finishes division.

◆

GENERAL MOTORS CORPORATION.—*H. B. Ellis*, director of parts and service of the Electro-Motive division of General Motors Corporation, has been appointed assistant to vice-president of G. M. C. The position of director of parts and service of the Electro-Motive division has been abolished.

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UNION RAILWAY EQUIPMENT COMPANY. —*L. F. Erskine* has been appointed district sales manager for the Union Railawy Equipment Company, with headquarters at Minneapolis, Minn.

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JOSEPH T. RYERSON & SON.—*Frederick A. Purdy* has been appointed manager of the new Los Angeles, Calif., plant of Joseph T. Ryerson & Son. Associated with Mr. Purdy is *Theodore L. Kishbaugh*, who has been named assistant plant manager. *Thomas E. Williams* will be in charge of

Frederick A. Purdy

the operating and service divisions. *George W. Gilliland*, who has been in charge of the Los Angeles office, will continue in a sales capacity. Other members of the field sales staff are *John Fennie, Harold Christian, Richard DeLand, Merle Anderson, Milford Tiner* and *Ernest Lindgren*.

Frederick A. Purdy joined Ryerson in 1931, two years after his graduation from the University of Michigan School of Engineering. He served first as an engineer at the Buffalo, N. Y., plant of the company and then represented the company in New York state, heading the Rochester (N. Y.) district sales office for four years.

CUMMINS ENGINE COMPANY.—*Leonard W. Beck* has been appointed acting general sales manager of the Cummins Engine Company, with headquarters in Columbus, Ind. Mr. Beck will be responsible for the over-all administration of the distribution division. He will also retain his duties as manager of the central region, to which

Leonard W. Beck

position he was appointed in 1939. *Fred W. Sparka* has been appointed manager of the Cleveland, Ohio, region to succeed *Byron A. Duling*, who has been assigned to the home office to work directly under Mr. Beck. *Corwin B. Briscoe* has been appointed acting parts merchandising manager at Columbus, and *Norman E. Palmer* Washington, D. C., representative.

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BUDA COMPANY.—*H. A. Wolfe*, railroad representative of the Buda Company, at St. Paul, Minn., has been appointed district manager of Buda's railroad division, with headquarters at Chicago, succeeding *Ross M. Blackburn*, deceased. *William A. Hart*, railroad representative at New York, has been transferred to St. Paul, Minn., succeeding Mr. Wolfe.

H. A. Wolfe was born in 1897, and received his higher education at Valparaiso University, Valparaiso, Ind. He entered railroad service in 1916 in the accounting department of the Chicago, Milwaukee, St. Paul & Pacific. Released from the armed forces in 1919, he returned to the Milwaukee as chief clerk to the general superintendent of motive power. In 1922 he was promoted to the position of supervisor of fuel. In 1926 Mr. Wolfe resigned from the Milwaukee to become special representative of the Lehon Company. In 1940 he was appointed supervisor of railroad sales. In May, 1944, he joined Buda as field representative. In April, 1946, he was transferred to St. Paul.

William A. Hart was born at Battle Creek, Mich. He is a graduate of Purdue University (1940) with a B. S. degree in mechanical engineering. In 1940 he joined the Buda sales department at Harvey, Ill. Early in 1941 he was transferred to New York to represent the railroad division in export and industrial sales through distributors. He entered the service of the armed forces early in 1942, and in November, 1945, returned to the Buda Company at New York, representing the industrial division in the northeastern territory.

NATIONAL ALUMINATE CORPORATION.—*A. Watson Armour* has been elected chairman of the board of directors of National Aluminate Corporation.

A. Watson Armour

SAFETY CAR HEATING & LIGHTING COMPANY.—*H. K. Williams,* vice-president of the Safety Car Heating & Lighting Company, has retired after 40 years' service with the company. Other retirements are *George H. Scott,* manager, Chicago district office; *A. B. Mills,* manager, New England district office, and *J. S. Henry,* manager, New York district office. Retirements at New Haven, Conn., include *George E. Hulse,* chief engineer; *L. Schepmoes,* manager, fixture department; *A. C. Van Nest,* chief supervisor; *J. C. Montgomery,* superintendent.

Appointments have been made as follows: *C. A. Pinyard,* manager, and *E. K. Goldschmidt,* assistant manager, Chicago district office; *H. W. Keyser,* assistant manager, Philadelphia, Pa., district office; *Wade M. Wilkes,* representative in charge, New England district; *W. P. Shotwell,* representative in charge, San Francisco district; *Pearce Whetstone,* executive office, New York; *Leonard Pierson,* assistant to vice-president C. W. Dunlop; *E. C. Mattern,* works manager; *L. Von Ohlsen,* electrical engineer; *J. D. Strobell,* air-conditioning engineer; *J. J. Kennedy,* field engineer.

ELLCON COMPANY; NATIONAL BRAKE COMPANY.—*Chester T. Stansfield* has been elected president of the Ellcon Company and the National Brake Company to succeed William M. Wampler, deceased.

Chester T. Stansfield was born in Worcester, Mass., and was educated in Philadelphia, Pa. He was engaged in various engineering capacities with industrial and marine equipment manufacturers from 1915 to 1921. He then joined the Ellcon Company. He served both in engineering and sales capacities; was elected vice-president and a director in 1936, and executive vice-president in 1944. Mr. Stansfield has been associated with National Brake since 1928. In 1940, he was elected a director and vice-president of that company.

Chester T. Stansfield

SKF INDUSTRIES, INC.—*Harrison Wood,* assistant district manager since 1941, has been appointed New York district manager for SKF Industries, Inc., to succeed *John D. Williamson,* resigned.

SYMINGTON-GOULD CORPORATION.—*Daniel C. Murphy,* formerly general manager of the Gould Coupler Works, Depew, N. Y., has been appointed vice-president in charge of operations of the Rochester, N. Y., and Depew plants of the Symington-Gould Corporation.

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*George C. Thiele* has been appointed assistant to the vice-president of Pullman-Standard.

Obituary

BROWNRIGG L. NORTON, assistant vice-president of the Scullin Steel Company at New York, died on September 14. Mr. Norton, who was 45 years old, had been associated with Scullin for over 20 years.

FRANK L. FAY, former president of the Greenville Steel Car Company, a subsidiary of the Pittsburgh Forgings Company, died on October 10 at Clifton Springs, N. Y. Mr. Fay was 77 years old. He was born in Cleveland, Ohio. He was first in the employ of the New York, Chicago & St. Louis and then joined the Bessemer & Lake Erie as head of the car-service department. He resigned in 1910 to found the Greenville Metal Products Company, which later became the Greenville Steel Car Company.

Personal Mention

General

I. N. MOSELEY, general boilermaker of the Norfolk & Western at Roanoke, Va., has been appointed research and test engineer, with headquarters at Roanoke.

C. L. CROCKETT, chemist of the Norfolk & Western at Roanoke, Va., has been appointed chief chemist with headquarters at Roanoke.

BRUCE C. GUNNELL, Diesel engineer of the Southern at Washington, D. C., has been appointed chief mechanical engineer at Washington.

A. R. SNYDER, superintendent motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., has been transferred to Cheyenne, Wyo.

L. L. HOEFFEL, superintendent motive power and machinery of the Union Pacific at Pocatello, Idaho, has been transferred to Salt Lake City, Utah.

H. N. RICKS, acting fuel supervisor of the Texas & Pacific at Dallas, Tex., has been appointed fuel supervisor, with headquarters at Dallas.

H. W. CODDINGTON, research and test engineer of the Norfolk & Western at Roanoke, Va., has retired after 43 years of service.

JOHN P. CHADWICK retired on October 1 as assistant to the vice-president (mechanical) of the Southern, with headquarters at Washington, D. C. Mr. Chadwick was born at Brooklyn, N. Y., on August 4, 1883, and began his railway career as a special representative at the Cooke Locomotive Works in Paterson, N. J. He subsequently served as draftsman, shop engineer, test engineer and as locomotive designer. Upon the formation of the American Locomotive Company, Mr. Chadwick was transferred to the main plant at Schenectady, N. Y., as locomotive designer, remaining there until May 15, 1906, when he entered the service of the Southern at Washington, D. C., as standardizing draftsman. He was promoted to chief draftsman in 1907 and in 1924 became mechanical engineer. On November 1, 1931, Mr. Chadwick was appointed assistant to vice-president (mechanical).

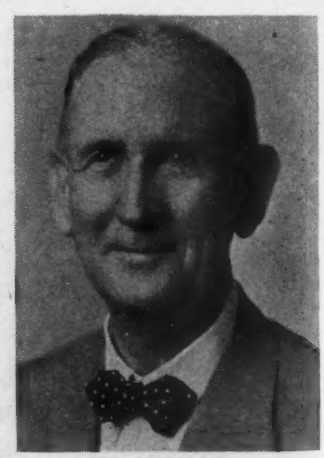
BLAIR L. THOMPSON, who has been appointed superintendent motive-power shops of the Canadian National at Winnipeg, Man., as announced in the September issue, was born on July 20, 1906, at Moncton, N. B. He received a high school education in Moncton and is a graduate of the International Correspondence School in shop practice and mechanical engineering subjects. He entered the employ of the Canadian National on November 1, 1923, as a telegraph messenger. On March 23, 1924, he became a machinist apprentice at Moncton; on March 27, 1929, a locomotive draftsman; on March 15, 1935, material inspector, Atlantic Region, with headquarters at Moncton, and on January 1, 1938, mechanical inspector, Atlantic Region. For several months during the period January

1, 1938, to August 16, 1943, Mr. Thompson was acting locomotive foreman at Sydney, N. S., and Moncton. He was appointed system mechanical inspector, with headquarters at Montreal, Que., on August 16,

B. L. Thompson

1943; night superintendent at the Point St. Charles shop, Montreal, on July 1, 1945, and superintendent motive power shops at Winnipeg on April 10, 1946.

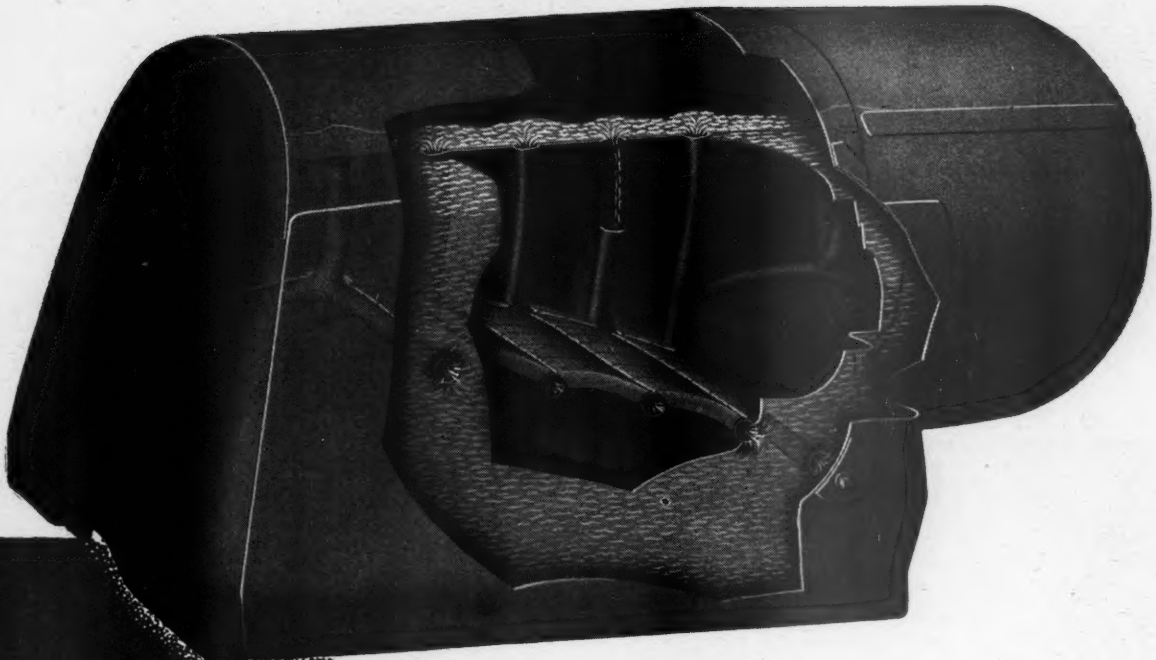
L. E. Dix, acting mechanical superintendent of the Texas & Pacific at Dallas, Tex., has been appointed mechanical superintendent, with headquarters at Dallas. Mr. Dix began his railroad career as a machinist apprentice on the Chicago, Rock Island & Pacific, at Horton, Kan. He later served as machinist on the Atchison, Topeka & Santa Fe and on the Missouri Pacific, and as master mechanic of the Union, a subsidiary of the Missouri Pacific, at Memphis, Tenn. In 1916 he was appointed master mechanic of the Texas & Pacific-Missouri Pacific Terminal, with headquarters



L. E. Dix

at New Orleans, La.; in 1920 master mechanic of the T. & P. with headquarters at Fort Worth, Tex., and in 1922 fuel supervisor. From 1941 to 1946 Mr. Dix served as president of the Railway Fuel Traveling Engineers Association.

Max Raven Brockman has been appointed assistant to vice-president (mechanical) of the Southern, with headquarters at



Washington, D. C. Mr. Brockman was born at Greensboro, N. C., on December 31, 1894. He entered railway service in March, 1912, as a machinist apprentice for the Southern at Greensboro, transferring to Spencer, N. C., in 1915, where he became a machinist in 1916. During World War I Mr. Brockman served as a machinist instructor at the U. S. Naval Aeronautic Training Station at Pensacola, Fla. In

Max R. Brockman

1918, he returned to the Southern as a machinist at Greensboro. He became night foreman at Charlotte, N. C., in 1919; from 1920 to 1926 served as general foreman at Selma, N. C., Greenville, S. C., and Ashville, N. C., successively, and from 1926 to 1944 as master mechanic at Bristol, Va., Macon, Ga., Somerset, Ky., and Spencer, N. C. Mr. Brockman became chief mechanical engineer at Washington in June, 1944, and assistant to vice-president (mechanical) on October 1, 1946.

Master Mechanics and Road Foremen

J. W. Mason, assistant master mechanic of the Central of Georgia, has been appointed master mechanic in charge of the Macon shops at Macon, Ga.

R. E. Whittaker has been appointed assistant master mechanic of the Illinois Central, with headquarters at Markham, Ill.

E. R. Hanna, master mechanic of the Missouri Pacific, with headquarters at Nevada, Mo., has returned to that position following a sick leave.

C. H. Dick has been promoted to general master mechanic of the Missouri-Kansas-Texas, with headquarters at Denison, Tex.

J. W. McKinnon, division master mechanic of the Canadian Pacific at Trenton, Ont., has been appointed district master mechanic, with headquarters at Toronto, Ont.

Car Department

Carl Dierks, chief inspector, car department, of the Delaware & Hudson, has been appointed assistant superintendent of car equipment, with headquarters as before

These General Motors Diesel units have rolled up a grand total of 8,984,058 miles. The average monthly mileage is 17,145—on heavy passenger runs.

RECORD ON FLORIDA EAST COAST RAILWAY

LOCOMOTIVE NUMBER	MILES COVERED	MILES ASSIGNED	AVAILABILITY	MILES OPERATED PER MONTH	DATE DELIVERED
1001	1,336,615	1,550,337	86.2	17,359	11-39
1002	1,480,614	1,572,899	94.1	19,229	11-39
1003	1,226,943	1,312,569	93.5	19,171	12-40
1004	950,848	986,143	96.4	19,017	2-42
1005	946,185	983,357	96.2	18,924	2-42
1006	178,419	180,746	98.7	14,868	4-45
1007	184,092	184,323	99.9	15,341	4-45
1008	149,872	150,201	99.8	14,987	6-45
1009	112,915	116,466	97.0	11,292	6-45
1010	149,336	149,682	99.8	14,934	6-45
1011	152,450	152,450	100.0	15,245	6-45
1012	107,674	107,674	100.0	10,767	6-45
1013	150,374	150,374	100.0	15,037	6-45
1014*	94,616	111,536	84.8	9,462	6-45
1015	103,454	103,454	100.0	10,345	6-45
1016	140,406	140,406	100.0	14,041	6-45
1017	109,408	109,737	99.7	10,941	6-45
1051	920,121	990,260	92.9	18,402	2-42
1052	189,672	189,672	100.0	15,806	4-45
1053	150,296	150,642	99.8	15,030	6-45
1054	149,748	150,786	99.3	14,975	6-45
21 locomotive units	8,984,058	9,543,714	94.1	315,173	

*Number 1014 lost 16,920 miles in October 1945 due to accident

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS   LA GRANGE, ILL.

at Albany, N. Y. The position of chief inspector, car department, has been abolished.

J. J. BARRY, division air-brake inspector of the New York Central at Buffalo, N. Y., has had his title changed to supervisor of air brakes and steam heat.

R. R. WINNE, division air-brake inspector of the New York Central at West Springfield, Mass., has had his title changed to supervisor of air brakes and steam heat.

H. S. KEPPELMAN has been appointed superintendent car department of the Reading with headquarters at Reading, Pa.

J. KANE, division air-brake inspector of the New York Central at Syracuse, N. Y., has had his title changed to supervisor of air brakes and steam heat.

Shop and Enginehouse

W. S. GARRETT, general foreman of the locomotive department of the Norfolk & Western at the Roanoke (Va.) shops, has been appointed general boilermaker.

Obituary

CHARLES A. BINGAMAN, who retired as assistant mechanical engineer of the Reading at Reading, Pa., in December, 1938, died there on October 2.

FRANK N. BURCH, master mechanic in charge of the Central of Georgia shops at Macon, Ga., died in that city on September 16, following a short illness. Mr. Burch was 59 years old. His birthplace was Paducah, Ky. For five months in 1907 he was employed in the shops of the Central of Georgia at Savannah, Ga. In October, 1913, he became a machinist at Macon and subsequently served as assistant machine-shop foreman, assistant enginehouse foreman, and erecting-shop foreman. On June 27, 1924, he was appointed assistant master mechanic and on February 1, 1943, master mechanic at Macon.

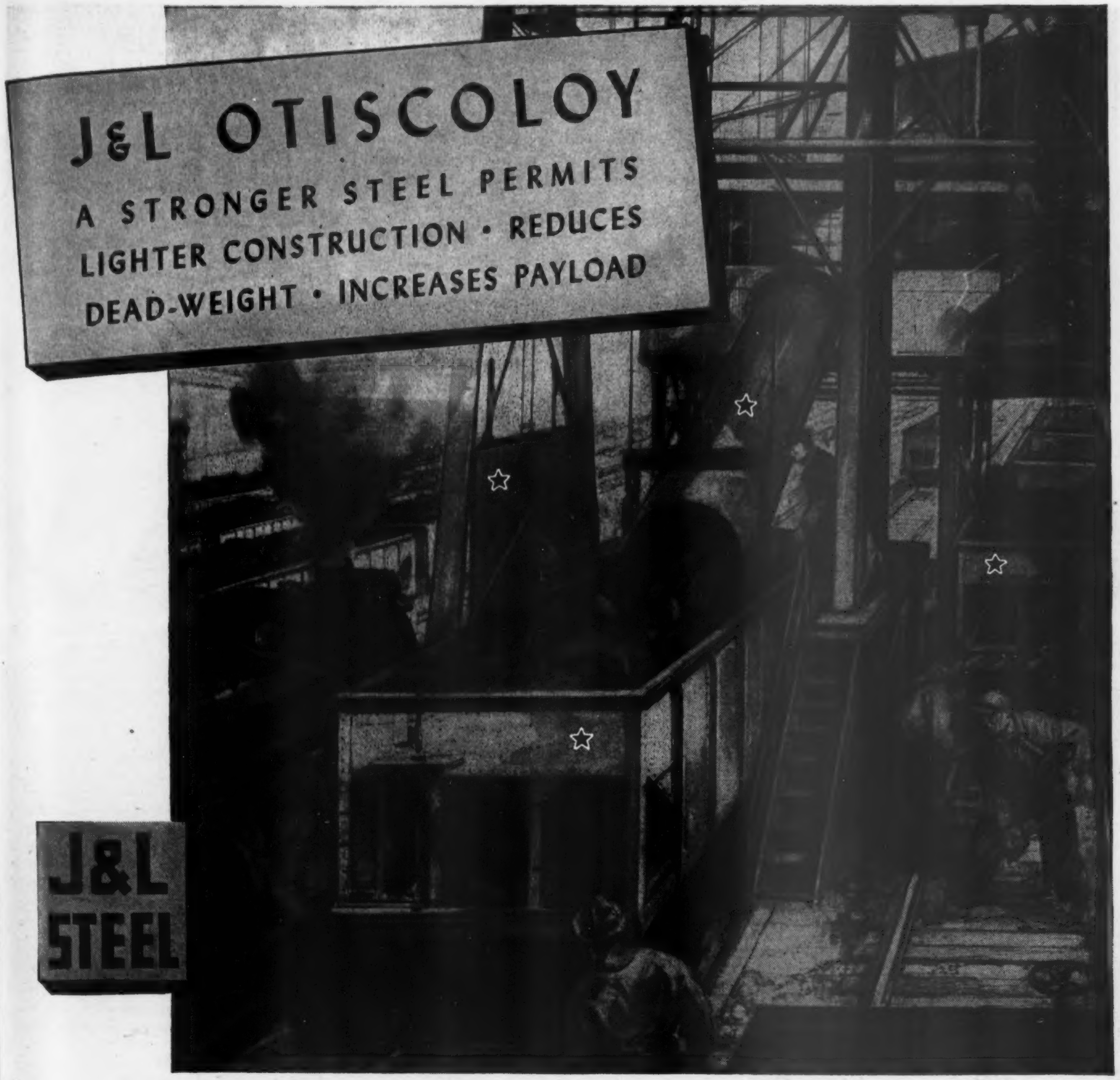
Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

B. & W. BOILER TUBES.—Joseph T. Ryerson and Son, Inc., Box 8000-A, Chicago 80. An eight-page illustrated bulletin describes and illustrates the stocks of Babcock & Wilcox electric - resistance - welded boiler tubes handled by the Ryerson plants.

◆

"LUBRICATION OF DIESEL ENGINES."—Sun Oil Company, Philadelphia 3, Pa, Forty-eight page Technical Bulletin No. B-1, printed in color, discusses the Development of the Diesel Engine; common types of Diesel engines the combustion process; modern fuel-injection systems; accessories, their design and use; cylinder and bearing


J&L OTISCOLOY
A STRONGER STEEL PERMITS
LIGHTER CONSTRUCTION • REDUCES
DEAD-WEIGHT • INCREASES PAYLOAD
J&L
STEEL

lubrication, and filters reclaiming equipment. Viscosity-temperature charts are shown and recommendations given for lubricating oils.

◆

PISTON-ROD PARTER.—Sperry Products, Inc., Hoboken, N. J. Four-page illustrated folder descriptive of the Sperry hydraulic piston-rod parter.

◆

DUST COLLECTORS.—Aget Manufacturing Company, 602 First National building, Ann Arbor, Mich. Catalogue A-350 describes Dustkop dust collectors for collecting dust, dirt, and lint from dry grinding, buffing, polishing, etc., also a vapor collector designed to collect vapor from screw machines and similar machining operations employing coolants.

◆

AERIAL CABLE.—Simplex Wire & Cable Co., 79 Sidney street, Cambridge 39, Mass. Data Sheets Nos. 116 and 117 cover the general subject of aerial cable, the latter specifically the self-supporting type.

◆

ELECTRODE SELECTION CHART.—Air Reduction Sales Company, 60 East Forty-second street, New York 17. A four-color, 25-in. by 40-in. chart for the use of operators in selecting the correct electrode for a particular job. Chart specifies which electrodes to use, shows currents, gives mechanical properties, and includes color guide which shows the electrodes in their actual colors. Included are electrodes for mild, alloy, and stainless steels, as well as for non-ferrous, cast-iron and hard-facing rods.

◆

STANDARD STOKERS. — The Standard Stoker Company, Inc., 350 Madison avenue, New York 17. Sixteen-page booklet, Publication No. 80, printed in color and bound with plastic. Describes the different types of Standard stokers and the advantages to be derived from mechanical firing. Cutaway locomotive illustrations in color show how the Standard MB, BK, and HT type stokers carry the coal from tenders to fireboxes and how the coal is distributed over the firebeds.

◆

DIESEL LOCOMOTIVE SANDER.—Ross and White Company, Chicago. A 6-page folder, Bulletin 61, describes the Diesel locomotive sanding equipment made by this company, including a new non-leaking sand valve and hose connection which permit controlling the sand flow directly at the sand box.

◆

O. T. C. TOOLS.—Owatonna Tool Company, Owatonna, Wis. A 100-page catalogue, 45-J, illustrates and describes the small tools made by this company, including Diesel-engine service sets, heavy-duty wrench sets and sledging wrenches adaptable to use in steam locomotive repair work.

◆

DILLON UNIVERSAL TESTER.—W. C. Dillon & Co., Inc., 5410 West Jarrison street, Chicago 44. Sixteen-page illustrated booklet, in color, contains a complete set of specimen charts by which materials with pounds per square inch up to 200,000 lb. can be quickly tested in the Dillon instrument by using reduced area specimens. Rectangles and rounds are fully covered.